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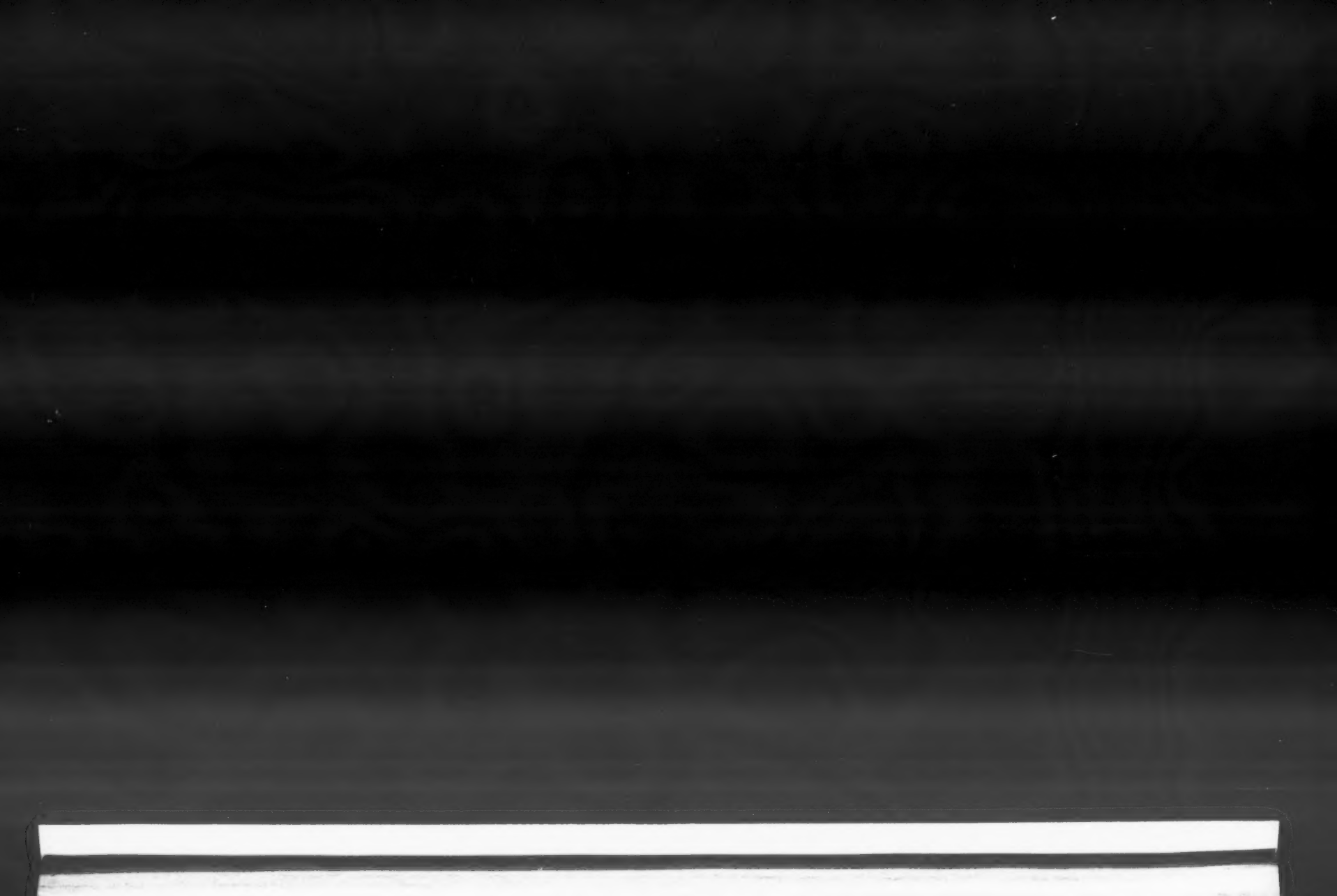
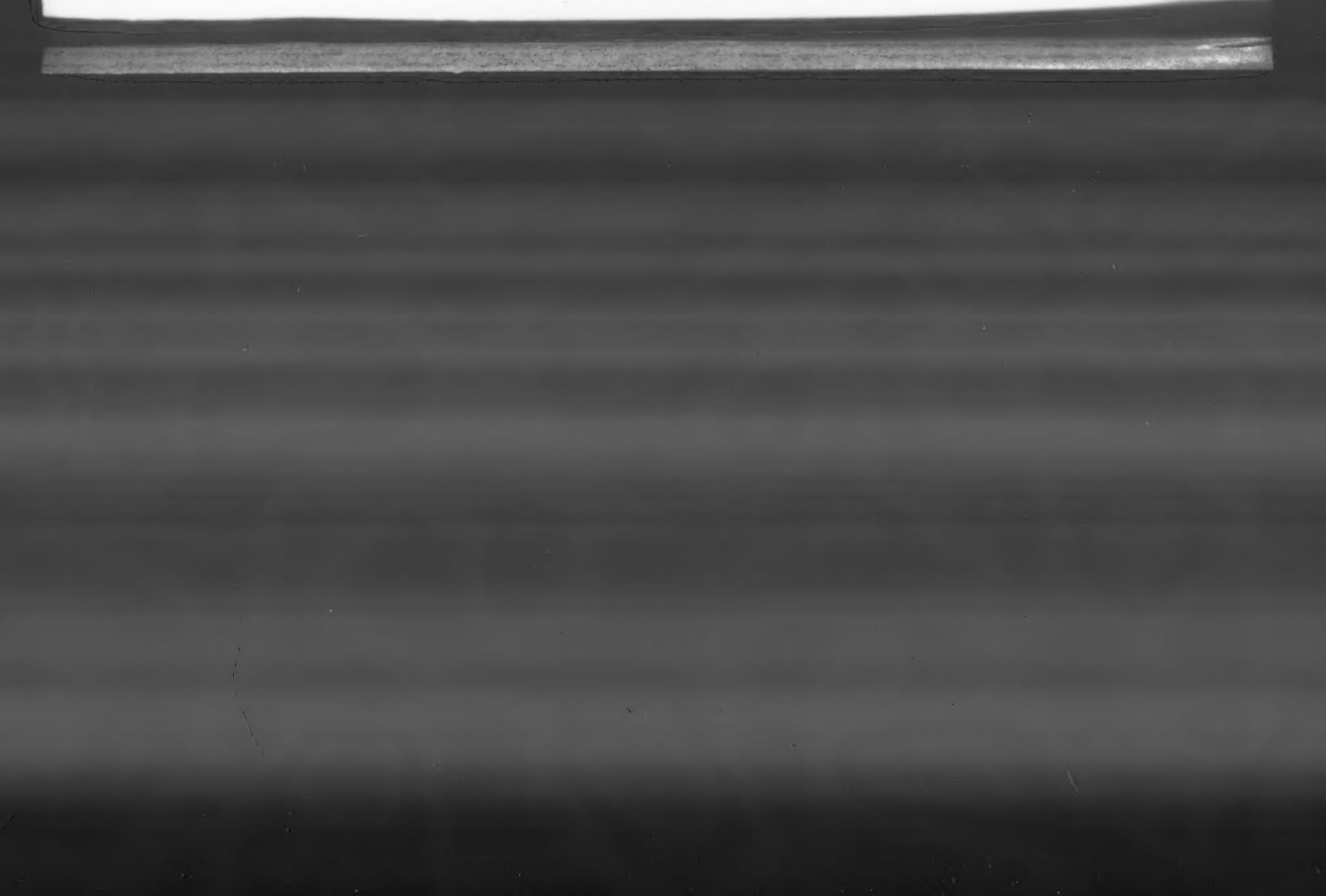




MUNICIPAL ENGINEERING

VOLUME XXIX. JULY, NINETEEN HUNDRED FIVE. NUMBER ONE

REDUCING THE FIRE HAZARD IN EASTERN CITIES.

By George E. Walsh, New York City.

The question of reducing the fire hazard in New York is now under discussion. A system of high-pressure salt-water pipes, operated by electric power or a battery of gas engines, has frequently been recommended for use in seaboard cities. Philadelphia has succeeded in reducing rates on $200,000,000 worth of risks 15 to 20 cents per $100 through the installation of a high-pressure system, and the question of New York adopting a similar system is now under serious consideration.

New York enjoys every facility for a high-pressure fire service. Down in the great business districts the question of pumping water up to the top stories of the high office buildings is a serious one with the fire department. With a high-pressure salt-water system this would be simplified, and the fire hazard would be reduced sufficiently to pay 10 per cent. or more on the investment.

The question of whether such a service would be operated by electricity, gas or steam is a live topic among engineers. From Philadelphia's experience the gas engine appears to have the advantage. The power plant in that city is equal in effect to forty engines, and where its six-hose hydrants stand there is no need to maintain engines. The plant is operated by eight 280-horse-power Westinghouse gas engines. The pumping capacity of these eight engines is 16,000,000 gallons of water each twenty-four hours, at a cost of about $392 per month.

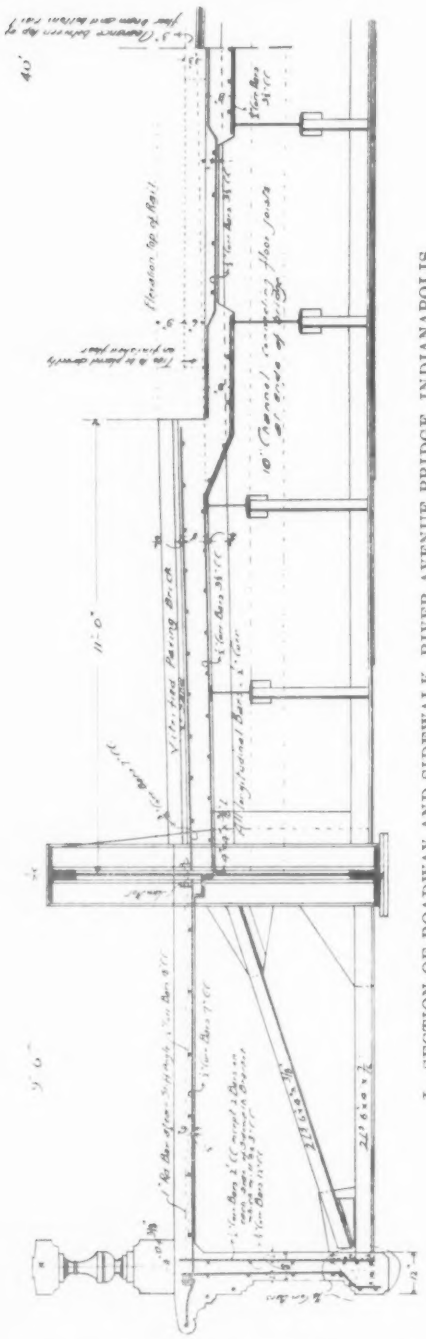
If a high water-pressure service is adopted in New York three or more stations will have to be installed, and possibly one or two in Brooklyn, with three 1,500-horse-power units, or a total of 4,500, in each station. This would give sufficient power to protect the business districts from any such conflagrations as that which destroyed Baltimore. Moreover, it would be an economy in comparison with the present system and in the reduction of the insurance risks.

The use of electric motors instead of gas engines to operate such high-pressure salt-water pumps would have many advantages over steam or gas. By means of electric power centrifugal pumps could be used, and this would give more uniform and powerful streams, which in the case of a great fire would prove of great importance. The installation of the electric motors would cost considerably less than that of gas engines. The electric motors would be ready for instant use. But if electric power had to be purchased at current rates, it is doubtful if this advantage could be maintained. Cost of operation, after all, is more important than that of initial installation. The very lowest price at which electric current is sold in New York is 5 cents a kilowatt, and unless the electric companies would make cheaper rates for the city the cost of operation would be in favor of the gas engine, with gas at $1 per thousand cubic feet.

The whole question seems to be summed up in the relative supply of gas and electricity. If the city operated its own electric lighting plant, the high-pressure salt-water fire service could be more economically run by electricity, but under the present conditions gas has the advantage in cost of operation. Electric current is not supplied in New York in any great surplus, and it is doubtful if there would be sufficient to operate three such stations of pumps as suggested without seriously interfering with the regular supply for lighting purposes and for operating machinery. On the other hand, gas is supplied abundantly, and in any emergency the amount in storage would be sufficient.

In cities where electric current could be sold in large quanties at low cost and in any amount of voltage in special emergencies, the electric operation of fire

pumps would prove by all odds the cheapest and most efficient. In such cities as



I. SECTION OF ROADWAY AND SIDEWALK, RIVER AVENUE BRIDGE, INDIANAPOLIS.

Buffalo, which enjoy the advantages of powerful current from Niagara, electric fire pumps should stand first in consideration.

The pumping stations proposed by the city's committee would not prove very desirable customers in one sense. The consumption of current would be very irregular. In ordinary times no demand for current would be made, but when a large fire did break out in the district covered by the high-pressure service, an enormous demand on the electric supply would follow. If this occurred in the middle of the night, it would not materially interfere with the ordinary supply, but it would in most cases, as shown by past fire statistics, happen during the busiest part of the afternoon or evening, when electric current is consumed in the greatest quantity. The tax upon the resources of the electric companies would be great, and in order to provide against contingencies connection would have to be made with all the generating plants. The investigation of the subject since the Baltimore fire has had the effect of bringing to light the actual conditions that exist in the city. It has been demonstrated that there is very little surplus electrical power for sale in either Manhattan or Brooklyn, and that there will be very little for some time to come. In fact, the growth of electrical industries and plants using this power has more than kept pace with the increase in generating plants. It is not possible, under present conditions, to make the addition of a station of 4,500-horsepower in an emergency without seriously interfering with the business of ordinary consumers, not even when connections are made with several of the largest stations.

According to the members of the committee appointed to investigate conditions in foreign cities, motor-driven fire-pumps have been in successful use abroad. In European cities the electric motor is used in place of the steam engine in a great many cases, and it proves lighter, more compact, and more efficient and less costly in the end. These motor-driven fire-pumps are drawn by horses. Electric power is supplied at nearly every street crossing, and when going to a fire the motors are drawn up to the nearest lamp-post. Electric attachment is then conveniently and quickly made.

"One thing about the foreign electric fire engines," explained an engineer who studied the subject in German and English cities, "is that powerful centrifugal pumps are employed, and the stream is not only greater than that obtained from our steam pumps, but it is more uniform. Moreover, the whole compact outfit on a light vehicle can be drawn through the streets much faster and easier than the clumsy steam affairs. Weight for weight, the electric-driven fire-pump will throw

nearly double the amount of water in a given time.

Uncertain about the time when a high-pressure salt-water service may be installed, builders and investors are resorting to self-protection by equipping their structures with electric pumps. The fire protective methods adopted by the large buildings are the most complete of their kind. They include one and two hundred horse-power motors, geared to pumps that will carry the water to any part of the buildings as needed, under a guaranteed pressure of 100 pounds to the square inch. This water is supplied either in the form of a sprinkler or a steady, powerful stream. The motors are water-proof, and can stand in several feet of water without being injured. Once turned on the water would continue to flow until the building was almost completely gutted.

The fire-pumps for this purpose are built with capacities from two hundred to a thousand or more gallons per minute, according to needs. Several of these have recently been installed, and it is safe to say that every high office building of the future in New York will be thus equipped. The Fire Insurance Underwriters not only approve of this system of fire protection in the new buildings, but they are seeking to make the equipment of this class of buildings with motor pumps compulsory.

The value of private pumps for protection of individual buildings has been repeatedly shown by recent great fires. In Baltimore several buildings protected by electric motor pumps were saved from destruction and serious injury by simply keeping the outside of the structures saturated with water. According to recent reports of the Fire Insurance Underwriters, fully five million dollars' worth of property were saved in the Baltimore fire by the few pumps used in the large buildings. Not only this, but the progress of the fire was checked in its advance by these stone buildings vomiting forth steady showers of water. As half the battle depends upon promptness of action in a fire, the electric pump stands first. Ready at all times, it can sprinkle any part of the building within a few seconds or minutes after the fire is discovered. While the fire companies are hurrying to the scene, the fire may, in many instances, be put out without doing much damage.

The electric motor pumps, which send a steady flow of water in streams and showers to all parts of the store, come the nearest of any invention to absolutely protecting goods in a department store. With stand-pipes running from a high-pressure service to every counter in the store, it is possible to sprinkle any section so quickly and completely that a fire would have no chance to spread. A perfect system would practically inclose a small fire inside a wall of dripping water, beyond which it would be impossible for it to extend. And this could be maintained as long as desired without risking the life of any one. The work would be done automatically until the fire was extinguished, or it had burned out. Electricity may have introduced a new fire danger element into our homes and stores through improper insulation, but it has apparently brought us the best possible means of fighting fire by confining it in a restricted area and automatically fighting it.

THE RIVER AVENUE BRIDGE, INDIANAPOLIS

It is said by those whose business it is to supply materials for concrete structures that Marion county, Indiana, did more concrete and reinforced concrete work during the last year, and has under contract for the present year, more than any similar area in the United States. This work consists of all classes of work, such as small box culverts, plain and reinforced concrete arch culverts, reinforced slab culverts, concrete arch bridges and reinforced concrete arch bridges of one to five spans. Many bridges and culverts of all kinds were washed out or very badly injured by floods in February and March, 1904, and they are all replaced by permanent structures.

Five of the large bridges over White river and Fall creek are in the city of Indianapolis, and appropriations for them varied from $75,000 to $168,000, the total appropriation for these five being $738,000. Contracts for two of the reinforced concrete arches have been let, and bids have been called for on a third. The contracts thus far awarded have been let at prices from $20,000 to $40,000 less than the appropriations made.

One of the bridges, that at River avenue, has some novel features, and illustrations taken from the plans are given herewith, which will show how the plans differ from those usual for structures of this sort, and how the problems which arise have been solved. Mr. Harry W. Klausmann, is the county surveyor of Marion county, and all the plans and the supervision of the construction are under his efficient management. The editor of MUNICIPAL ENGINEERING has been closely

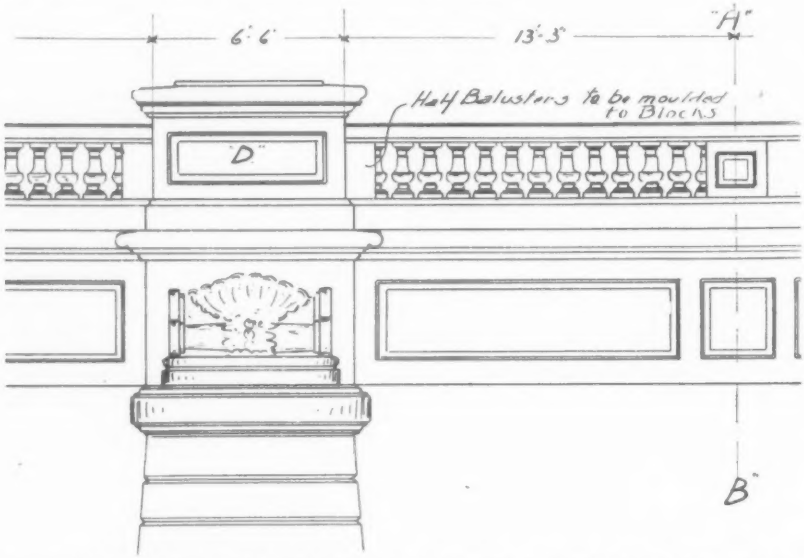
connected with much of the work on the five large bridges as the chairman of a city Bridge and Stream Improvement Commission, which was formed with the object, first, to aid in securing the appropriations for the bridges upon a scale adequate for the needs of the case, and later, to serve as a center for the correlation of the work of city and county, so that all the work done in the city by the various authorities would have a unity, which would not be possible were there absolutely independent action. We are indebted to Mr. Klausmann for the accompanying illustrations.

The substructure of the River avenue bridge is of concrete, and consists of two abutments and four piers. The contract for this portion of the work was secured by the Moore-Mansfield Company, of Indianapolis, at the following unit prices: Wet excavation, $2.70 a cubic yard; piling, 30 cents a linear foot; concrete, $4.77 a cubic yard; curbing, 60 cents a linear foot; brick roadway, $1 a square yard; grading, 30 cents a cubic yard; graveling approaches, 60 cents a cubic yard, the total estimated cost being about $55,450.

The concrete foundations are placed on hardwood piles. The specifications for the forms for the structure above low water read as follows:

The forms for casing all concrete work shall be substantial and of timber of such thickness and stiffness and so braced that they are unyielding when the concrete is placed and rammed next to them. The forms for the various concrete structures shall be truly established and maintained by the contractor, so that the completed work shall conform in dimensions and position to the plans. In order to attain a smooth and satisfactory finish of all concrete surfaces exposed to view, the forms shall be plastered to a perfectly smooth finish with rock plaster, stucco, or other plastering material that will adhere to the forms. Before the concrete is deposited against the forms the plastered surfaces shall be coated with a soap sizing sufficient to prevent the plaster from sticking to the concrete. No plaster need be used whenever the width and length of one planed board or plank of well-seasoned timber will cover the whole surface of any plane, but no board marks or stains caused by wood acid or other imperfections will be allowed.

The facing of the work is provided for as follows:



II. CONCRETE PIER AND REINFORCED CONCRETE GIRDER AND BALUSTRADE, RIVER AVENUE BRIDGE, INDIANAPOLIS.

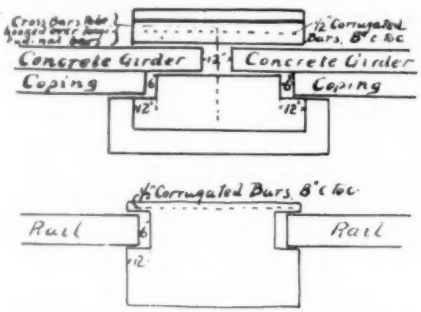
All exposed surfaces shall have a mortar face of a minimum thickness of two inches. The mortar facing must in every case be built up with the concrete, and no plane of demarcation or any plastering will be allowed. The mortar shall be composed of one part Portland cement and two and one-half parts clean sharp sand, measured loose.

Crushed stone, passing a ⅜-inch mesh, was afterwards substituted for the sand. The concrete in the substructure is in proportions of 1:3:5, the latter being broken stone or washed gravel passing through a 2½-inch ring. The coping is 1:1½:2½ of broken stone passing a 1-inch ring.

The headroom above floods is so restricted at the location of this bridge and the length of the bridge is so definitely fixed that it was necessary, in order to give the utmost water way possible, to make the

openings between piles rectangular. Through plate girders were therefore used to carry the 40-foot roadway, with double street car track. Outside of these plate girders are placed 9½-foot cement sidewalks, which are supported by the plate girders, with some assistance from two reinforced concrete girders on the outer side of the sidewalk.

The accompanying half cross-section of the bridge shows one of the main girders in section, a floor beam, sections of the longitudinal girders, section of the reinforced concrete floor under one roadway, and one-half of the trough for the street



III. EXPANSION JOINT OF REINFORCED CONCRETE GIRDER, RIVER AVENUE BRIDGE, INDIANAPOLIS.

railway roadbed. Outside of the main girder it shows a section of the reinforced girder, with the locations of the reinforcing bars, section of the reinforced concrete sidewalk, section of the concrete railing showing location of the longitudinal stiffening bars, and the brackets from the main girder which aid the concrete girders in carrying their load.

The second cut shows the side elevation of a pier and of the reinforced concrete girder. The important problem in this girder is the allowance for temperature stresses so that no cracks will occur in the concrete. It is believed that this is taken care of by the method of breaking up the length of the girder into short spans, acting as continuous girders over the supporting brackets, and by the allowance of an expansion joint, shown in the accompanying small drawing, which is self-explanatory. There is one of these at each end of each of the reinforced concrete girders.

The fourth drawing shows the construction of the balusters for the railing and the location of the reinforcing rods, which project at each end for attachment to base and rail.

The appearance of the completed bridge is suggested by the accompanying photograph of part of a wash-drawing.

The roadway is of brick. Ornamented lamp posts are provided at each pier. The trolley poles are set on each pier in a space left between the ends of the plate girders, which is duly covered and protected.

Concrete for the various parts of the superstructure is of the following proportions:

For the girders, 1 part Portland cement and 3 parts clean sharp sand.

For sidewalks, 1 cement, 1½ sand, 2½ crushed gravel passing a ½-inch ring.

For roadway, 1 cement, 2 sand, 4 crushed gravel passing a 1-inch ring.

For pedestals, buttresses and balustrade, 1 cement, 1½ sand and 2½ crushed gravel passing 1-inch ring.

For joint seats and mud walls, 1 cement, 3 sand, 5 gravel passing a 2½-inch ring.

All cement is Portland, measurements are made loose and concrete is machine mixed.

The mortar facing is 1 inch thick, of 1 part Portland cement and 2½ parts sand, afterwards changed to Bedford stone passing a 3-8-inch mesh screen.

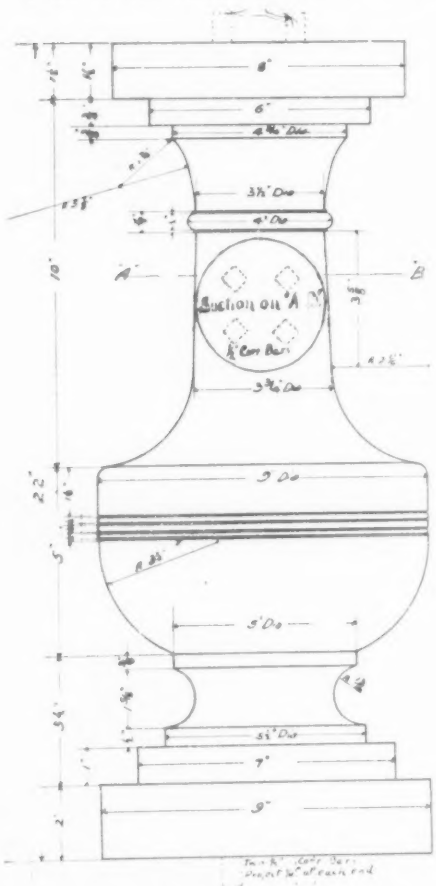
Corrugated bars are used for reinforcement.

The total cost of the superstructure, complete, five spans of 85 feet each, is $58,350. The estimated total cost of the bridge is $113,800. This leaves a large balance of the appropriation of $165,000 made for the bridge.

OPERATION OF SAND FILTERS OF INDIANAPOLIS WATER WORKS.

By W. C. Mabee, Constructing Engineer.

The following description of the method dianapolis Water Company is taken from a paper, by Mr. W. C. Mabee, constructing engineer for the company, which he read before the Indianapolis Technical Club. A few additions to the paper are made by the editor, on account of the



IV. DETAILS OF BALUSTER, RIVER AVENUE BRIDGE, INDIANAPOLIS.

completion of the construction of the beds. The construction of the filters was described and illustrated in the April number of MUNICIPAL ENGINEERING, page 321.

When the proper amount of sand has been spread evenly over the bed, it is in condition to be operated immediately. Pure water is backed into the new filter, from the clear water basins, entering the underdrains until the level is about a foot above the sand, when the raw water is turned in, bringing the level to its maximum height. Several days elapse before filtration is started, in order that the bed may ripen and form the "Schmutzdecke" on the sand surface.

The valves controlling the effluent are then opened and the telescopic weir adjusted to a one-million-gallon rate, which is gradually increased in the course of twenty-four hours to two and one-half million gallons per acre per day, which rate is maintained or increased, depending upon the turbidity of the raw water entering the beds, and the bacterial content of the filtrate. Rates as high as five million gallons can safely be maintained when the applied water is fairly clear.

Cleaning the Beds.—When the bed has become so clogged that the desired rate of filtration can no longer be maintained, the bed is drained and scraped. Fifty-three men are employed a day and a half, using specially designed scoops (shown on the photograph, Plate I), and wheelbarrows on run planks. The depth of scraping is as near one-half inch as possible, removing about 210 cubic yards from each bed at a cost of about 70 cents a cubic yard. The period between throwing a filter out of service for the purpose of cleaning and putting it back into service again is usually three days. For the present, the dirty sand is being stored, but it is the intention of the Water Company to install the hydraulic method of removing and cleaning sand. This consists of a 6-inch pipe delivering water at 80 pounds pressure to a portable hopper fitted with a Korting ejector, and a 3-inch discharge pipe, leading to the portable booster or sand-washers, also provided with Korting ejectors and additional pressure pipes. At the sand-washer the dirty water overflows weirs and passes off into the sewer. The clean sand is conveyed by water to the sand bins, and there stored until it becomes necessary to recharge a bed, which generally occurs once a year.

The plant is managed by a superintendent, having a night and a day engineer, two firemen, a night watchman, a janitor and three laborers.

This force is increased at the sand-cleaning periods.

The bacteriological work is done at the laboratory, located on the grounds.

The bacteriological examinations made in this laboratory are toward two ends—

an estimation of the numbers of bacteria present, and a determination of the presence or absence of B Coli Communis, the type form of intestinal organisms.

To obtain the numbers of bacteria present, a measured quantity of the sample is taken, usually one centimeter, and imbedded in a sufficient quantity of standard nutrient gelatine, this nutrient gelatine being a combination of beef tea and ordinary sheet gelatine. The theory of the operation is this: Each organism present in the sample becoming imbedded in the jelly-like mass, a most favorable habitat, proceeds to reproduce of its kind to such degree as within about seventy-two hours to render the entire body of organisms thus produced visible to the eye, as a series of small dots in the medium, which are easily enumerated. By no means are all the organisms in the water estimated in this manner, a great many not growing upon gelatine; there being a number of groups such as the nitrifying bacteria and cellulose forming bacteria, which do not find it a favorable habitat. But all types shown are derived either directly or indirectly from sewage or decomposition products, and the count thus made includes every form of ordinary interest and of sanitary significance.

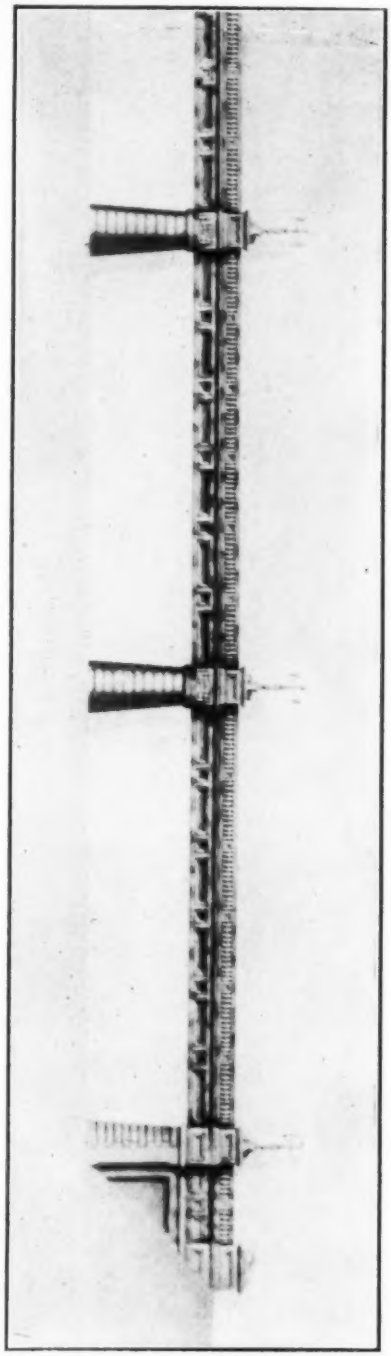
As to the number of bacteria in an effluent water from a filter, there are many factors to be taken into consideration, but it may be generally stated that a reduction of 98 to 99 per cent. represents a satisfactory result, though the nearer 100 per cent, one is able to get, the more satisfactory the result becomes.

If, however, the bacteria remaining in the effluent water are of no significance, so far as indicating dangerous sewage contamination, a lower reduction of bacteria is permissible.

The determination of the presence of the B Coli Communis marks the second stage of the ordinary water examination. The methods of its determination are too complicated and tedious to be dwelt upon here. Suffice it to say that B Coli is so like the bacillus involved in the souring of milk and some forms found upon grains that it must be determined with all possible accuracy to make its finding a matter of any significance.

The B Coli Communis is the type form of intestinal bacteria, being always present in the human intestine, and also in the major number of the lower animals.

Whether or no B Coli, upon being found in a water, indicates contamination with typhoid excreta, has been the subject matter of innumerable papers and studies. The general opinion is that it does not, unless very often found. C. E. A. Winslow, Professor of Bacteriology in the Massachusetts Institute of Technology, in a personal conversation, said: "In a municipal water supply, I would regard the finding of B Coli in a majority of samples necessary to indicate dangerous pollution.



V. HALF ELEVATION OF RIVER AVENUE BRIDGE, INDIANAPOLIS.

From 10 to 15 per cent. positive results from filtered samples examined are to be expected in the best managed filters."

It is understood, therefore, that the Colon Bacillus affords a valuable index to the potable quality of a water supply when it is taken into account that it must be encountered in normal waters and the conclusions are based upon a conservative viewpoint.

Reduction of Bacteria.—The first run of Filter Bed No. 2 showed a reduction in bacteria equal to 99 per cent. The length of the run was forty-two days, and the quantity of water run off was 145,000,000 gallons. The bacteria in the raw water reached a maximum of 4,500 and a minimum of 175 per c.c., with an average of 810 bacteria per c.c. The bacteria in the pure water reached a

Maximum	number	of	50,
Minimum	"	"	4,
Average	"	"	8,

making the average reduction 99 per cent.

The effective size of the filter sand taken from Bed No. 3 is 0.30 m.m., with a uniformity co-efficient of about 3.10. The water, on passing through the filters, emerges clear and sparkling.

A report on a run of 100,000,000 gallons through filter bed No. 1, during the spring of 1905, showed a bacterial efficiency of 99.85 throughout the run, the average number of bacteria being but 6 to the cubic centimeter.

A system of piping, supported on brackets, was installed surrounding each filter bed and adjusted just at, or slightly above, the water line to prevent ice from forming against the walls, which, upon expanding, would exert a pressure tending to injure the walls.

During the winter the ice proved to be a great hindrance to operation of the filter plant, inasmuch as the beds could be cleaned only by removing great quantities of 12-inch and 16-inch ice. Otherwise there was no interruption.

On account of this trouble, the freezing of the sand in the filters and the possible growth of algae in the filtered water, the company is now constructing arched roofs over the filter beds.

On the completion of the canal intake and back-filling the approaches to the aqueduct, described in the former paper, the water for the filtration plant was obtained from White river, and the entire system operated by gravity. Experience has demonstrated that the units of the system, as at present constructed, are too large to be handled economically, and it is the intention of the Water Company to divide the beds into two units where they now have one.

I. METHOD OF CLEANING FILTER BED.

Tests for Leakage.—Bed No. 1 was tested for leakage in May, 1904, the duration of test being sixteen days. The test showed the maximum shrinkage to be one inch in twenty-four hours and the minimum 3-8 inch.

Bed No. 2 was tested in June, 1904, and showed a shrinkage in thirty days of 16 inches, 5 5-8 inches of which was due to evaporation, making a net loss of 5-16 inches per day, or one-fifth of 1 per cent. of the water filtered when operating at a 4,000,000-gallon rate.

Filter No. 3 was tested for eleven days in October, and showed a net shrinkage of 7-16 inches per day. Recent tests made in very cold weather, showed a somewhat greater shrinkage, due, no doubt, to the contraction of the concrete.

The clear water basin covers were carefully gone over and calked with oakum,

but it was found that tar and pitch did more than anything else that was used, so the oakum was taken out and the roofs went through a winter with the tar and pitch.

An interesting and economical method of securing the sand for the filter beds and the sand and gravel for the construction of the works was developed on the ground and may be described in this connection.

The work of producing the gravel and sand for construction purposes, suitably screened and washed and in sufficient quantities, was one of the largest problems to contend with. Several months' experimenting with sand pumps proved the method a failure under our conditions, as the material could not be pumped in paying quantities.

The next experiment was with a Hay- of operating the sand filters of the Inward orange peel excavating machine, placed on the bank, with a 90-foot boom having a swing of a quarter circle. This machine would lift a cubic yard of sand and gravel from the bed of the creek and deposit it in a hopper, through which was passing an 8-inch stream of water. Screens were placed beneath the hopper, separating the gravel and discharging the sand and water into an enclosure, allowing the wash water to run off. The gravel was shot from the screens into cars and hauled to the filter beds by a locomotive furnished by the Vulcan Iron Works, of Wilkes-Barre, Pa.

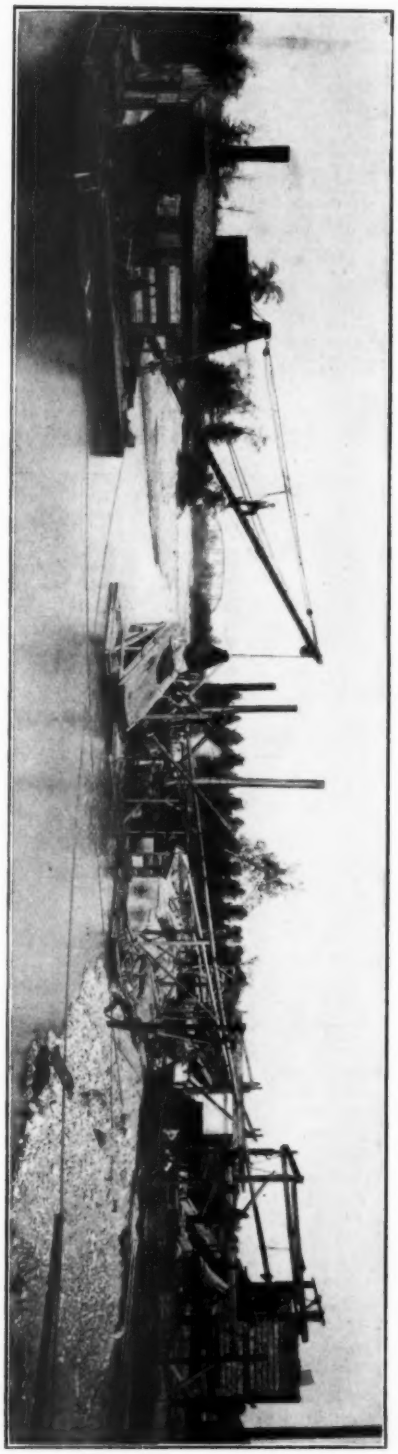
The separated sand contained considerable buckshot gravel, and it was necessary to rescreen and rewash it to make it suitable for filter material.

The writer evolved a double hopper, placed directly over the car track, having trap doors in the bottom of it. The sand was elevated to a platform above a screen by an endless chain, where it was mixed with water from a 5-inch stream. The screened sand and wash water were then carried to the hoppers above mentioned, from which the wash water was led off by weirs placed at the sides of the hoppers. About 125 yards a day were handled in this way.

Later it was decided to put all the machinery on boats, as the changes of location on the land came frequently and were expensive. This proved to be a decided success and large quantities of sand and gravel were produced, and of perfect cleanliness.

A submerged crib was built and attached to one of the boats on which was located the gravel pump.

The Hayward machine referred to deposited a cubic yard a minute on to a rack placed over the submerged crib. This rack separated the boulders, which



ILL. DREDGING AND PUMPING SAND AND GRAVEL.

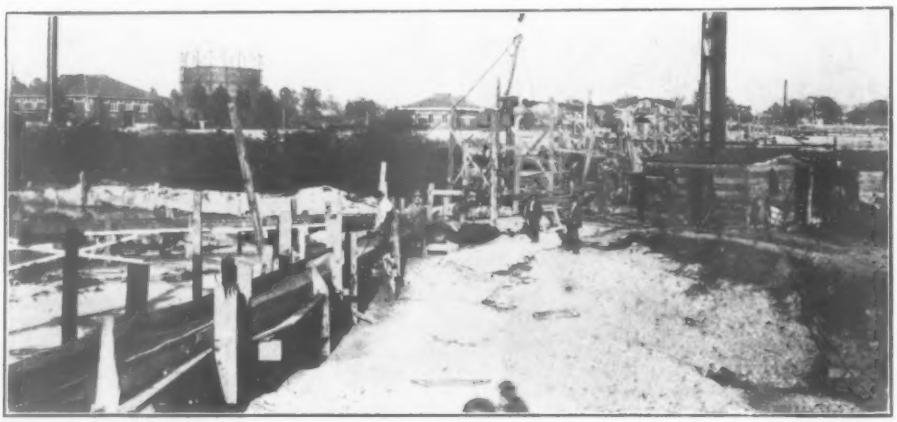
bounced off into the creek. The pump could now handle the gravel, because the boulders were removed and the mass loosened up. The flow of the creek was continually passing through the crib, so that the material was cleansed perfectly. Finding this a success, two pumps were set, producing, on an average, 360 yards of sand and gravel a day, the greatest single day's delivery being 567 cubic yards.

Plate II shows this part of the apparatus, the excavator, mounted on a double boat being seen on the left, the screen over the crib for the screened sand and gravel in the center. The two pumps for pumping the gravel and sand from the crib are on a boat at the right of the screen and the two discharge pipes from these pumps are seen running up to the right to two sets of screens for separating

Plate V shows the location of a valuable drain under the clear water basin, the use of which is thus described in the paper:

Serious difficulties were encountered in the excavation of the clear water basins, as the lower five feet were in water. It was also desired to preserve the sides of the excavation nearly vertical, so as not to disturb the foundation for the filter walls and floors.

This was accomplished by sheeting the sides and holding the sheeting back by wires passed around stakes placed in the filter beds. The ground water was taken care of by excavating a trench three feet wide down the center, extending the entire length of the basin, the bottom of the floor of the basin at the upper end, which was two and one-half feet below and three and one-half feet at the lower end. In the bottom of this ditch were



III. PUMPING SAND.

the sand from the gravel, one of which is seen on the extreme right of the picture.

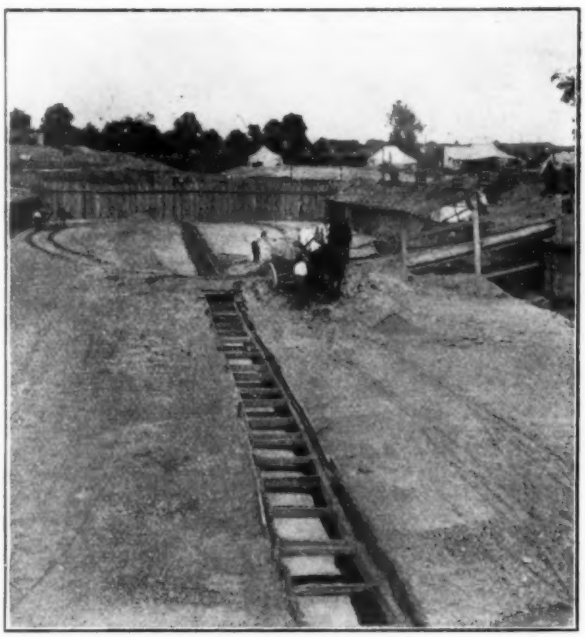
The sand and water, after leaving the screens, were guided by a trough to a second pump, which elevated it for the second time and transported it through an 8-inch pipe to the edge of the filter beds, and discharged it mixed into a large box, holding seven cubic yards, arranged so that the wash water would easily escape, leaving the sand to be shoveled directly into the filter bed. Plate III shows the trough, the second pump and the 8-inch pipe, but disconnected at its highest point and not in operation. Plate IV shows the receiving boxes at the filter beds, of which there are two, operated alternately so as to keep the gang distributing sand constantly busy.

There were 30,000 cubic yards of filter material used and 19,500 cubic yards of sand and gravel in the concrete construction, exclusive of the conduit lines.

placed three lines of rectangular underdrain tiles that were culled from the filter beds, and these were covered with boulders and gravel up to the floor line. Two 8-inch centrifugal pumps were operated day and night on each of these basins until they were completely finished and filled with water. This method proved to be a very successful way of draining the excavation.

The flood of March 26, 1904, caused the ground water to rise twelve feet above its normal level and the lower clear water basin, not having sufficient loading to resist this pressure at that time, was forced up along the center of its bottom, and was afterward repaired by tapping into the underdrain above mentioned, and thereby lowering the ground water. The fact that this form of underdraining was adopted proved to be very fortunate for the contractor.

IV. DEPOSITING SAND ON FILTER.



V. CONSTRUCTING DRAIN UNDER CLEAR WATER BASIN.

EDITORIAL COMMENT

The Engineer's Fault.

Prices of Building Materials.

Construction in Artificial Stone.

THE ENGINEER'S FAULT.

Before a recent meeting of the Society of the Municipal Engineers of the city of New York, Mr. John C. Wait read a paper with the above title, in which he told some rather unpleasant truths as well as upheld some contentions of engineers which they have not been able to induce municipal officials to approve. Mr. Wait was formerly of counsel to the city of New York and has shown his familiarity with what may be termed engineering law in several books upon the subject. He speaks with the authority due his special knowledge. One or two of his points will have consideration here, having more particular reference to the relation of the engineer to the legal profession in the enforcement of contracts.

Mr. Wait says:

The prosecution of a law suit involves first a clear and lucid declaration of the facts in the case. Conclusions, statements of law and arguments should be omitted from the complaint, as they have their place in subsequent proceedings. Lawyers depend largely upon engineers to assist them in the collection and presentation of these facts, and therein lies two-thirds if not four-fifths of the battle. If this be true, and I do not think it can reasonably be denied, it must be conceded that frequently there is more truth than libel in the frequent arraignment of lawyers that the loss of the case was the engineer's fault, meaning thereby the witness's fault.

The chief reasons why engineers do not make successful witnesses are, in my opinion, the lack of thorough understanding between the attorney and engineer; the want of information on the part of the engineer as to the shape in which the facts must be presented to the court, and a lack of self-possession, and the prompt comprehension of the English language by the engineer.

It is not to be wondered that there should exist a strong antipathy between the engineer and the lawyer, and it finds an expression on the part of both sides in contemptuous expressions, and especially after an advocate has been defeated by the testimony of an expert engineer more carefully schooled and trained in the art of answering questions by his opponent than his own witnesses. It is my opinion that it is the engineer's fault that experts have the awful reputation which the legal profession give to them for the reason that they permit themselves to be biased and be made advocates by the lawyers themselves.

This is the lawyer's side of the case. It is unquestionably true that there is often a lack of thorough understanding between the attorney and the engineer, not only as to the shape in which the facts must be presented to the court but also as to the bearing of the facts upon the case. It has been the writer's experience that the unfavorable outcome of a case is as often to be attributed to the failure of the lawyer to understand the engineering facts as to present his facts in the exact form desired by the lawyer. In fact, he has seen an attorney of reputation and standing so utterly unable to put a slightly complicated question upon surveying that he asked the permission of the court to have the question formulated by his engineer. He would be likely to be the first to express contempt for experts and especially for the expert upon the stand, because that gentleman did understand the English language and answered his questions as put, according to his demand, rather than as he desired to put them.

Much is said about expert testimony which is similar to Mr. Wait's expression, and the writer believes that it is most of it undeserved, for the same reason the restrictions Mr. Wait puts upon the engineer's understanding of how to put facts before the court are undeserved. The lawyer must have a theory upon which to prosecute his case and this theory must be based upon his understanding of the facts. If he does not understand the statements of fact and gets started upon the case, he is, of course, desirous of presenting the facts which will support his theory and of suppressing those which will not support it. The honest expert can not do this without becoming the biased advocate which Mr. Wait condemns. He has three horns to his dilemma, inability to induce the lawyer to change his theory to fit the facts, his repugnance of suppressing the facts which are unfavorable and his inability to twist the statements of fact which remain to consist with each other and with his conscience and at the same time aid the lawyer's theory of the case.

It is unfortunately true that many engineers do not understand the English language, and the writer has contended many years for better instruction in this line, with excellent results if one may judge by the greater importance now as-

signed to this subject in most of our leading engineering schools. But it is equally true that most lawyers do not understand engineering language and principles. The loss of cases is more often due to the latter fact than to the former. Several lawyers who took the writer's advice that they add at least a partial engineering course to their preparation for the law have since expressed their great satisfaction with the results.

The condition of the expert put on by one side or the other is similar to that of the engineer who has assisted in preparing the case, except that he seldom has the same opportunity to influence the presentation of the case, and is therefore even more helpless in his attempts to answer the questions put to him as the attorney who has called him desires and at the same time tell the "whole truth," which his oath as a witness requires. His failure to answer satisfactorily is not due to his inability to understand the English language, but rather to his unwillingness to distort the truth to fit the answer expected. Experts should be called by the court and should be questioned by both sides, and also by the court, with the purpose of bringing out all the facts and not alone those which the attorneys on one side have assumed to have a bearing on the case, and are favorable to them.

Mr. Wait has certainly had much experience and undoubtedly he speaks from the wealth of that experience, but this article is also a record of experience and is presented as a brief for the engineer's side of the case. Doubtless the examination of an unbiased expert, with the purpose of getting at all the facts, would add still more value to the discussion.

PRICES OF BUILDING MATERIALS.

The March issue of the *Bulletin of the Bureau of Labor* has many tables of the course of wholesale prices from 1890 to 1904, which are very significant. The following are selected for comparison and the prices are given in percentages of the average price from 1890 to 1899, that the variations may be most clearly stated and that the comparisons between the various materials may be more easily made. The first column shows the variations in price of common brick in the years from 1890 to 1904, the average price for the year being compared with the average price for the years 1890 to 1899, and the percentage computed as given.

The second and third columns show the same for domestic Portland cement and for Rosendale cement.

The fourth, fifth and sixth columns show the same for three timbers selected as representative of three classes of lumber.

The prices on which the percentages are based are for these materials in New York, the average for the year being the average of the prices quoted on the first day of each month.

	Common Brick	Domestic Portland Cement	Rosendale Cement	White Oak	White Pine	Poplar and Spruce
1890	118.0	.....	118.8	98.6	96.4	102.0
1891	102.6	.....	106.2	100.7	98.1	100.7
1892	103.7	.....	109.2	100.7	99.8	100.5
1893	104.9	.....	100.0	101.1	106.6	102.1
1894	89.9	.....	104.5	97.4	103.0	98.7
1895	95.5	98.6	96.1	98.0	99.8	97.6
1896	91.0	100.2	93.9	99.2	98.3	97.2
1897	88.8	98.5	84.8	98.6	96.0	96.2
1898	103.4	100.1	85.7	97.3	94.8	97.2
1899	102.2	102.6	100.8	108.4	107.7	107.7
1900	94.4	108.1	114.6	114.6	124.6	119.3
1901	103.7	94.7	114.8	104.2	125.9	115.0
1902	96.8	97.7	97.5	113.4	149.0	127.4
1903	106.2	101.6	100.3	129.6	156.1	137.4
1904	134.7	73.2	90.4	137.3	154.2	140.2

These prices show first, a lowering from 1890 to a minimum in 1897 or 1898, and a subsequent increase, due to the general trend of trade conditions. The summary of all commodities in the report shows this same variation from 112.9 per cent. of the average from 1890 to 1899, in 1890, down to 89.7 in 1897, and up to 113.6 in 1903, and 113.0 in 1904.

It is evident from the comparison of the figures in the table above, with the averages for all commodities, that there are other sources of variation in prices of the building materials included in the table. There is a sharp and continual rise in the prices of lumber which can only be explained by the fact that the supplies of lumber are diminishing. We are rapidly passing down to the poorer qualities of lumber on account of depletion of stocks of the better grades, and there is a consequent stiffening of prices in all grades.

There is but little fluctuation in the price of common brick, the variations, aside from those with general trade conditions, being due probably to the demands of the local New York market as compared with the local supply. There is shown, however, on comparison with the average of all commodities, an indication of comparatively less increase in price since 1897, except for 1904.

The general tendency of the cement market is downward. There are greater fluctuations up and down, especially in Portland cement, than for the other materials in the table. These have been ac-

counted for heretofore in this magazine by the rapid increase in the use of cement, which has received checks occasionally on account of business or building trade conditions, and the even more rapid increase in output of cement, which has been steady, as well as rapid. The cheapening of the cost of manufacture of cement has permitted a reduction in price, which has enormously increased the use of cement. But increase in the price beyond a certain figure, dependent on the relative prices of other building materials, cuts off some of these new uses and reduces the rate of increase in production with consequent reaction upon price. The inability of the smaller mills to manufacture cement when the price falls below a certain minimum adds complication to the variations. The variations in price have been sharp because the increases in use and in production have not been made uniformly, and trade conditions have therefore varied greatly even from month to month. The average price at New York for 1890 to 1899, with which the comparison is made, being practically $2 a barrel for domestic Portland, it is not likely that the percentage will greatly exceed 100 at any time in the near future.

Cement construction has a field of its own. It also competes with brick and will compete with wood. It is possible that the competition of cement has kept down the price of brick, as shown in the table. If the cost of lumber continues to increase in the ratio of the last five or six years, the time when cement can compete on equal terms with wood, as to cost, will come very soon. When that time comes, there will be a large increase in the use of cement and a corresponding increase in demand upon the mills. If the improvement in methods of cement construction is as rapid as it should be, depending, as it does, almost entirely upon the education of the men engaged in it, there will be no check on this account. It may be said, therefore, with considerable confidence that the development of the cement industry has but just begun.

CONSTRUCTION IN ARTIFICIAL STONE.

MUNICIPAL ENGINEERING was the first to call attention to the dangers involved in the methods of exploiting the business of selling machines ror making hollow concrete blocks and in the lack of care and business sense in the manufacture and sale of the products of these machines, and no one regrets more deeply that some of its predictions have been fulfilled. There are now, however, definite signs that the bottom has been reached and that the march of improvement has begun. Some of the block manufacturers, who began wrong and seriously handicapped themselves by their early errors, have stuck to the business and have learned how to make good blocks. By hard work and good work they are slowly living down their past mistakes and are building up trades among satisfied customers which are bound to increase as the public becomes convinced of the value of the material which can be turned out by those who know how.

The dealers in machinery have most of them learned their lesson, and are now more careful to instruct their customers in the best methods of making blocks and of developing their trade.

The early work in artificial stone other than that made by machines, or in factories, had its depressing effect upon the industry. While such structures are perfectly safe, their appearance, on account of defective surfaces, is objectionable and the prejudices formed have extended to other classes of cement work where appearance is an important factor. But there is a marked improvement in this work, on account of the development of better methods of finishing surfaces and adequate provision for temperature changes, shrinkage, etc., and such structures as the newer bridges in Washington, D. C., the new arch in Newark, N. J., the concrete girder in Indianapolis, described and illustrated in this number, will have their effect upon the upward tendency of concrete in public opinion, if their durability is equal to their promise.

The time for disparagement of concrete work and methods has passed. The lesson has been learned by the majority. It is now time to begin the building up of the great industry, which is certain of a success which will be attained just as rapidly as the trade learns how to do good work and how to introduce it on good architectural and business principles. MUNICIPAL ENGINEERING will continue its efforts in the advance of the procession and in preparing articles in all lines of concrete construction which will serve as guides and instructors for the earnest workers who are striving for the best, and who will give the business the standing which it deserves.

THE QUESTION DEPARTMENT

REMOVAL OF NAME FROM PAVING PETITION.

Can you refer me to, or tell me of any decision that has been passed in the State of Illinois, or any other State, where a property owner, having signed a petition for the improvement of a street and the petition having been filed, can legally remove his name?

GEORGE P. LOOMIS,
Chicago, Ill.

A search of MUNICIPAL ENGINEERING magazine brings to light a report of an opinion from Colorado, vol. xiv., p. 46, upon this subject. It is given by City Attorney Norris, of Denver, and is to the effect that a petitioner can not remove his name after a petition has been received by the board and acted upon.

The construction of the Indiana law by the city attorney of Indianapolis is to the effect that a name can not be removed from a petition after the day of final action upon the improvement resolution, based on the petition. The new law has not been in operation long enough to have come before the courts, but the procedure under the old law was the same and it does not seem to have been passed upon by the courts.

Can our readers refer us to any definite court decisions on the question?

CONCRETE PAVING BRICK.

We desire your opinion as to the practicability of paving block made of concrete. Would they be apt to give satisfaction as a substitute for vitrified paving brick, so commonly in use at the present time?

BLAKE LUMBER AND COAL CO.,
Wolcott, Ind.

Cement street pavements made like cement sidewalks have been in use in Bellefontaine, Ohio, for nearly fifteen years and have given satisfaction so far as durability is concerned, but there has been some complaint of their slipperiness. These pavements were described in MUNICIPAL ENGINEERING, vol. xvii, p. 383; and vol. xix, pp. 410 and 427.

More recently, concrete pavements have been built on about the same specification, in several cities which are described in MUNICIPAL ENGINEERING, as follows: Those in Grand Rapids, Mich., in vol. xxiii, p. 400; those in Toronto, Can., in vol. xxvii, p. 350; and those at Richmond, Ind., in vol. xxviii, p. 386. The pavement in New Orleans, between street car tracks and not subjected to wagon traffic, was not so successful. It is described in vol. xx, p. 341.

None of the pavements take the form of bricks or blocks. They are all laid in large blocks like sidewalks, the surface in some cases being grooved in smaller sections to remove the slipperiness. While they have all been fairly satisfactory, except the one in New Orleans, which has not been subject to wear of traffic, it is probable that a pavement laid with cement bricks or blocks would not be equally so. A pavement with many joints requires a material which is tough as well as hard. There is, for example, much difference in the wearing qualities of blocks made of different qualities of sandstone, the more brittle and pliable stones wearing rapidly, while the tougher varieties wear in a manner more satisfactory than some varieties of granite. There would probably be a similar difference between bricks of vitrified clay and of concrete. The matter has not yet been tested and this opinion is, therefore, based only on a knowledge of the general characteristics of the materials compared.

COST OF OPERATING MUNICIPAL ELECTRIC PLANT.

We are experiencing some difficulty in arriving at a basis for arranging a tariff rate for electric consumers on a day current.

The rates to be arranged are generally for consumers of electricity where motors are to be supplied, and ranging from ½ to 20 horse-power per motor.

Generally speaking, what is the ordinary cost of producing the electric current to supply motors of this nature, as experienced by other plants operated on a municipal basis?

Where can I get books or reliable authority dealing with the cost of operating and maintaining electric plants, also the cost of production and supplying electric currents?

W. E. FULK, Supt.,
Decatur, Ind.

With reference to the cost of generating electric currents there are several articles in MUNICIPAL ENGINEERING. One in vol. xxv(p. 252, gives data on the cost of furnishing current per kilowatt-hour in Massachusetts towns. The minimum cost reported for street lighting is 4½ cents a

kilowatt-hour and the maximum is nearly 49 cents, the average being about 11½ cents. This is the cost with profits, if any, on private lighting profits credited to the plant. Vol. xxi, p. 394, has a table of cost of street lights purchased from private plants, which shows an average of about 9 cents a kilowatt-hour.

Vol. xxii, p. 106, has a table of rates in Iowa towns, which shows that the popular meter rate is 10 cents a kilowatt, one being as low as 6 cents and one as high as 20 cents. Private plants are paid an average price per kilowatt of $0.0986 in the same state. The average price per kilowatt-hour throughout the United States, is given in vol. xxii, p. 416, as 12.3 cents, and the average minimum charge to large consumers as 5.1 cents. In vol. xix, p. 258, will be found tables giving more detail of conditions and the price per kilowatt-hour, as stated in the tables for municipal plants, varies from 16½ cents in small plants of 50 to 75 horse-power, to 4½ cents in a large plant, 3,000 to 5,000 horse-power, with some irregular figures between. There are many other equally valuable articles in other volumes of MUNICIPAL ENGINEERING.

The book giving most detail about cost of operating electric plants is the report of the Department of Labor of 1899, on "Water, Gas and Electric Plants." Foster's "Electrical Engineer's Pocket Book" ($5) is the only text-book known to the writer which gives much information about cost of operation. See vol. xxiii, p. 262, for list of books on operation of electric light plants.

It is evidently assumed in the above that the charge is to be made for power on the basis of meter readings. When motors run continuously they may be tested and a flat rate might be fixed, but if they are irregular in their action the meter should be the most satisfactory maker of bills for both parties.

GAS RATES AND COST OF PRODUCTION.

Can you give us correct net gas rates in all of the cities of the United States? We would also like to know if you can advise us where we can get information from the best authority on the cost of producing gas.

C. W. L., Cleveland, Ohio.

Brown's "Directory of American Gas Companies" ($5) gives gas rates for all cities.

Statistics of the cost of production in detail in nearly all the plants in the United States, and averages, will be found in the report of the United States Commissioner of Labor for 1899, on "Water, Gas and Electric Light Plants Under Private and Municipal Ownership."

MAKERS OF WHITE ENAMELED BRICK.

Can you tell us who make white enameled brick?

U. B. K., Cambridge Springs, Pa.

The names of makers of white enameled brick at hand are the Tiffany Enameled Brick Co., Momence, Ill.; Andrew Ramsay, Mt. Savage, Md.; American Enameled Brick and Tile Co., 1 Madison ave., New York. Houston Bros. Co., Pittsburg, Pa.; W. W. Clarke & Son, Baltimore, Md., and Charles Warner Co., Wilmington, Del., are manufacturers' agents and dealers.

MUNICIPAL YEAR BOOKS.

Will you kindly review for me in your magazine the books, "Municipal Manual" and "Municipal Year Book"?

ROBERTO L. LUACES,
Camaguiley, Cuba.

The "Municipal Year Book" ($3) was reviewed in MUNICIPAL ENGINEERING, vol. xxiii, p. 473. It gives statistics for nearly all cities, towns and villages of more than 3,000 population in this country regarding water works, electric light, telephone and telegraph, sewerage, garbage, heating, names of officials, etc., and is a very valuable collection of such data. It collects some of these data in summaries and gives some discussions of various interesting features.

There is a similar "Municipal Year Book" for England, with more descriptive matter, which is issued by the *Municipal Journal* of London, England.

The writer knows of no "Municipal Manual," aside from various annual publications by cities, giving names of officials, budgets, expenditures, etc., some of them going almost to the extent of being annual reports. The true title of one referred to by this title in a recent number of MUNICIPAL ENGINEERING is "The Municipal Yearbook."

Various books on municipal subjects have been reviewed in MUNICIPAL ENGINEERING from time to time, such as McCullough's "Municipal Public Works," in vol. xx., p. 106; Whitney's "Municipal Public Works," in vol. xxv, p. 274, and others.

BOOKS ON SMALL SEWER SYSTEMS.

Will you please recommend a book on planning and constructing a sewer system for a small town. Wish one that particularly refers to towns with light grades.

T. S. A., Saltillo, Coahuila, Mex.

Probably Staley and Pierson's "Separate System of Sewerage" ($3) is the book meeting our correspondent's needs most nearly, though Folwell's "Sewerage" ($3) is also an excellent book in this line.

AIR LIFT PUMPS—METER BOXES.

Can you give me names of firms who manufacture devices for lifting water by air pressure?

I shall be pleased to have names of firms manufacturing meter boxes for installing and enclosing water meters where the same are set on the outside, or any suggestion that might be available relative to the construction of a "home-made affair," one that will keep out water and frost and be serviceable in protecting meters in this latitude.

W. E. F., Decatur, Ind.

The following firms manufacture air lift pumps:

American Steam Pump Co., Battle Creek, Mich.; Bacon Air Lift Co., 92 William St., New York City; Clayton Air Compressor Works, 114 Liberty St., New York; Foster Pump Works, 224 Plymouth St., Brooklyn, N. Y.; Hall Steam Pump Co., Allegheny, Pa.; Ingersoll-Sergeant Drill Co., Old Colony Bldg., Chicago, Ill.; Norwalk Iron Works Co., South Norwalk, Conn.; Pneumatic Engineering Co., 85 Cedar St., New York City.

Meter boxes are made by T. H. Brady, New Britain, Conn., and H. W. Clark, Mattoon, Ill. The city engineer of Richmond, Va., can give some interesting information about methods of setting meters outside houses, which could doubtless be modified to suit conditions in colder climates.

BOOKS ON WATER PURIFICATION.

What is a good treatise on coagulation as applied to the purification of water for city purposes?

J. L. S., Morelia, Mex.

The following books treat this subject specially:

Hazen's "Filtration of Public Water Supplies" ($3).

Fuertes' "Water Filtration Works" ($3.50).

Rideal's "Water and its Purification" ($3).

BOOKS ON PLUMBING INSPECTION.

Can you tell me where I can get a good set of plumbing specifications or a hand book on plumbing. I want something of every-day, practical use, that will enable me to judge of the quality of plumbing materials as well as of plumbing work. I am not hunting for a general treatise on sewerage, sanitation and plumbing, but want a specification that will insure me a good job of ordinary house plumbing.

S. S. E., Cedartown, Ga.

Probably Gerhard's little books are most nearly what are wanted. They are "Recent Practice in the Sanitary Drainage of Buildings" (50 cents) and "House Drainage and Sanitary Plumbing" (50 cents). They are companion volumes and are both good, the former, perhaps, answering most completely the description given.

BOOKS ON THE SEPTIC TANK.

What is the best thing published on the building and working of the septic tank for the disposal of sewage?

IRA L. HOFFMAN,
Baker City, Ore.

The editor may, perhaps, be pardoned for suggesting that the back numbers of MUNICIPAL ENGINEERING contain from time to time what, in his opinion, is the latest and best on this subject. In books, when quality and quantity of information are considered, and also price and the needs of this correspondent, the following may be named in order:

Rafter's "Treatment of Septic Sewage" (50 cents).

Barwise's "Purification of Sewage" ($3.50), English.

Dibdin's "Purification of Sewage and Water ($6.50), English.

Moore's "Sanitary Engineering" ($10 net), English.

Baker's "British Sewage Works" ($2).

Rideal's "Sewage" ($3.50), English.

PROPORTIONS OF CONCRETE MATERIALS.

I wish to find a book that will tell how much concrete a barrel of cement will make, mixed in different proportions with sand and gravel. Also the top of sidewalks in different proportions, as many of the specifications that I work to specify much more cement than others.

A. STEFFEN, Havana, Ill.

The chapter in the "Handbook for Cement Users" ($3) on "Data for Estimates of Cement Work" gives the desired information for average conditions. The chapter on "The Uses of Cement" contains instructions for determining the proper proportions for any given materials.

REINFORCED AND FIRE PROOF CONCRETE.

Does the "Handbook for Cement Users" treat fully of concrete for fireproofing, and of concrete for reinforced cement floors, giving different kinds of reinforcement, sizes of reinforcement and amount needed for different size spans and loads, thickness of floors for various loads and spans, mixtures of concrete, and best method of using?

L. BROS.,
Cedar Rapids, Iowa.

The "Handbook for Cement Users" ($3) gives a list of the different kinds of reinforcement, mixtures of concrete and best method of using. The sizes and amounts of reinforcement needed for different spans and loads and thicknesses of floor depend on the system adopted and can not be given in great detail in a book of this sort. The manufacturers of the various systems furnish information about their particular product and reference must be made to them or to a competent engi-

neer who can design the floor for the system, span and load specified. General tables would be unsafe, because they would be misused by ignorant builders. The fireproof qualities of concrete are shown. The methods of application depend upon the system used and economy requires a plan for the work made by a competent engineer or builder of experience, who can suit his plan to the special conditions of the particular case. Some hints can be gathered from this book, as well as others, like Marsh's "Reinforced Concrete" ($7), or Buel and Hill's "Reinforced Concrete" ($5).

INFORMATION ABOUT CONCRETE BLOCK MANUFACTURE.

We have been referred to you by the bureau of chemistry of the department of agriculture, for information on the manufacture of concrete building blocks or concrete bricks. Will you kindly send us such pamphlets or circulars of information that you have on the subject, or refer us to some one who has it, and oblige

DICKMAN, WILCOX & CO.,
Oconto, Neb.

The volumes of MUNICIPAL ENGINEERING for the past three and one-half years are the best and the only complete source of information concerning concrete block manufacture and cement bricks, and the machines for making them. There is not room here to give a full list of the articles on these subjects. Copies of the indexes of these volumes will be sent on application.

The "Handbook for Cement Users" ($3), the third edition of which is just issued, also has much valuable information upon this question.

STRENGTH OF HOLLOW BLOCK WALL.

I would like to answer the question of C. B. D., Sidney, Ohio, in the June number, by saying that I built last year for the Old Homestead Canning Co., of Picton, Ont., a two-story block building, 100x50 feet, on a 9-foot concrete foundation. The first story was 14 feet, the second 12 feet, without crosswall or pilaster. The walls are of one-piece 10-inch hollow blocks, laid in cement and lime mortar. On the first floor is all the machinery for the running of a first-class canning factory. On the upper floor is stored over 200 tons of goods. There has been no bulging or settling. Two months from the day the first sod was thrown out the machinery was in operation, which I consider a very severe test, as the building could not get cured in that time. If this information is of any use to your readers, you may publish it over my signature. Any doubting Thomas that wants to see for himself may do so by coming to Picton, Ont., and if the building is not all right I will pay his expenses.

FRED E. M'DONALD,
Bloomfield, Ont.

CEMENT IN SEA WATER.

I have read with some interest the letter of Mr. George C. Blance, of Winter Harbor, Maine, and the comment thereon, which appears in the Question Department of the June number of MUNICIPAL ENGINEERING.

I think it a pretty well established fact that there is no cement made in this country today that will successfully withstand the corrosive action of sea water. This is due to the fact of the presence of alumina, the salts of which are readily acted upon by the sulphates in sea water. The only cements known to the writer that successfully withstand this corrosive action are the iron ore cement of Kruppe, Germany, and some of the French cements, in none of which alumina is present beyond possibly 1½ per cent.

It may be of interest to yourselves and to your readers to know that our company is now perfecting a cement, which is practically non-aluminous, and which experiments made so far with concentrated solutions of the deleterious salts in sea water show is not affected in the least by them. This cement is silicious and very like the sea-water cement made by the Societe I. & J. Pavin de Lafarge, of Marseilles, France, only it is some higher in oxide of iron.

I shall be very glad to hear from any of your readers who are interested in cements that will withstand the corrosive action of sea water, either through your columns, or personally.

All of our work on the cement herein referred to has been done in the laboratory.

W. P. D. MOROSS,
Mgr. Chickamauga Cement Co.,
Chattanooga, Tenn.

Not all our readers will agree in full with the statements made above, and we shall be pleased to publish discussions of the question which are founded on thorough chemical study, or upon the results of experience in laboratory, or in actual construction in sea water.

CEMENT DIRECTORY.

Will you kindly advise me if there is a directory published of cement users in this country; that is, contractors, engineers, etc.

C. O. FERGUSON,
Indianapolis, Ind.

This inquiry comes to us by way of a correspondent in New York, to whom it was sent, thus giving an illustration of the proverb, "A prophet is not without honor save in his own country." The third edition of the "Directory of American Cement Industries" ($5) is now on the market and contains, in addition to the information desired, lists of manufacturers of, sales agents for and dealers in cement, cement brands, cement block makers,

makers of and dealers in machinery for cement manufacturers and cement users, foreign manufacturers of cement, and descriptions of the cement plants and the brands of cement made in this country. It is the only book of its kind and is a practical necessity to the live manufacturer and dealer in cement, as well as to the engineers and contractors using cement who wish to be fully posted upon the various brands of cement and manufacturers of the same.

BOOKS AND MAGAZINES ABOUT CONCRETE BUILDING BLOCKS.

Please give me the names of works on concrete building blocks, also the names of magazines published entirely in the interests of manufacturers and salesmen of this artificial stone.

C. M. Y., San Francisco, Cal.

The concrete block business is so new that there are few publications treating of it. The "Handbook for Cement Users" ($3) devotes considerable space to the manufacture of blocks and the systems in use. Hagloch's "Art Stone" ($1.50) is a small book devoted almost entirely to cement blocks, but some manufacturers make objections to his statements regarding methods. Paul Wilkes has a pamphlet on "How to Manufacture Concrete Blocks," which he sells at 50 cents.

There is no periodical devoted entirely to the interests of concrete block manufacturers. Nearly all periodicals in the building trades, especially those treating specially of concrete and cement, devote space to the subject. No one was earlier in the field than MUNICIPAL ENGINEERING and it has kept record of all the successes and failures in the business from the beginning, having been the first to take up this new method of construction.

HOW TO COLOR CONCRETE.

Can you tell me how to color concrete red or natural brick color?

S. A., Green Bay, Wis.

The "Handbook for Cement Users" ($3), the third edition of which has just been issued, recommends six to ten pounds of raw iron oxide for a red color and six pounds of Pompeiian red for a bright red color, for each 100 pounds of cement. The exact shade desired must be found by trial, as the sand and stone, as well as the cement, and the proportions in which they are used, affect the color.

WHEN IS A CONCRETE MIXER ECONOMICAL?

On a street paving contract, of say $40,000, when broken stone is to be used for a concrete base, would it not be best to buy a concrete mixer rather than use shovels and platform? Could not much more and better work be done with a mixing machine, especially a power machine?

In this locality we have excellent gravel absolutely clean. All we need is to dig it from the pit, so my experience has been only with gravel for concrete.

E. M., New Castle, Ind.

Whether the material is broken stone or gravel makes no difference, so far as the value of a mixer is concerned. A good mixer makes better concrete than mixing by hand, and may often permit the use of less cement on this account. The size of contract at which it becomes profitable to purchase a mixer is hard to fix. First, is the cost of the mixer. Then, for street work, comes the cost of the frequent moving that is necessary and the cost of delivering materials at each stopping place of the mixer and cleaning up after the moving. Small mixers are used quite successfully for sidewalk work, but the requirements are different for street foundation work and a contractor may easily lose all the advantage the mixer gives him by mismanaging his receipt of materials and delivery of concrete. The contract spoken of is probably not large enough to warrant the purchase of the best mixer and distributer of concrete for street foundation, though its use might be successful if the contractor already had one on hand. Will the practical contractors among our readers give us the benefit of their experience?

PLANS FOR BUILDING CEMENT STEPS AND SPECIAL CEMENT WORK.

Can you put me in the way of finding plans for building cement steps for residences and public highways; also plans for fancy walks and fences?

A. N., Alma, Neb.

Full description of a method of building cement steps will be found in the "Handbook for Cement Users" ($3), the third edition of which has recently been issued. It probably contains all the information needed for doing the kinds of work named.

Mr. Paul Wilkes, who wrote the article on cement posts in the May number of MUNICIPAL ENGINEERING, furnishes plans and molds for all kinds of artificial stone. J. M. Keith & Co., Des Moines, Iowa, also furnish artificial stone apparatus. Reference should be made for names of other makers of and dealers in similar apparatus to the "Business Directory" printed in each number of MUNICIPAL ENGINEERING, under the headings, "Artificial Stone," "Concrete Blocks," "Concrete Construction Machinery."

CONCRETE MIXER FOR BLOCK PLANT.

Can you put me in the way of getting information about and price of a concrete mixer for building block purposes?

C. E. C., Lansing, Mich.

Probably a small batch mixer would be best for a block plant unless it is very large. Reference to the "Business Directory" printed in each number of MUNICIPAL ENGINEERING, under the heading. "Concrete Mixers," will secure names of makers of mixers, some of which may be found suitable for the size of our correspondent's plant. Will our readers who have been using mixers in their plants report their experience?

HOW TO BUILD CEMENT SIDEWALKS.

Will you kindly give me the latest and most successful methods of building cement sidewalks?

W. B. N., Ridgway, Pa.

There are two places to get instruction in the best methods of laying sidewalks. One is the "Handbook for Cement Users" ($3), the third edition of which has just been issued. and the other is the back numbers of MUNICIPAL ENGINEERING, in which there has recently been much discussion of the subject. Specifications for various qualities of work will be found in vol. xxviii, pp. 459 and 134, not to mention earlier volumes. The subject of foundations has been quite fully discussed in the same volume, pp. 451, 311, 225. There is much more upon this subject in earlier volumes.

REINFORCING WATERING TANK.

I want to build a stock watering tank 8 feet in diameter. How should it be reinforced?

E. K., Creston, Iowa.

If the concrete is 6 or 8 inches thick it will need no reinforcement. If any is used it may be ordinary fence wire, barbed or not, but for ease in keeping in place during construction some form of woven fence wire or poultry netting may be most satisfactory.

COLORS FOR CEMENT WALKS.

Please inform me what is the best thing to color the top dressing for concrete walks and floors, what is its cost and where I can get it at least expense.

C. F., Everett, Pa.

The material to use will depend upon the color wanted. The different colors have considerable differences in price. Instruction as to what to use and how much will be found in the "Handbook for Cement Users" ($3). The manufacturers of mineral paints also make mortar colors. Lampblack is also used. Names of dealers in coloring matters will be found in the "Business Directory" printed in each number if MUNCIPAL ENGINEERING under the headings, "Builders' Supplies," "Contractors' Supplies."

HANDBOOK OF STRUCTURAL FORMS.

Can you put me in the way of procuring a handbook of structural forms, as now produced and standardized by the principal mills, as the "Carnegie," "Cambria," "Illinois Steel Works," etc.?

O. T. R., Wellington, Kan.

Application to the firms whose books are mentioned will procure copies, as they are sent to any one having actual use for them. The fifth edition of Osborn's Tables has just been issued by the Osborn Engineering Co., Cleveland, Ohio, and can be procured from them at a low price. It is brought down to date and contains the standard forms and combinations of forms and tables of their properties.

INSPECTION OF CEMENT BLOCKS.

We are thinking of putting up a store building of cement blocks. It is a new thing there, and I would like to learn something about it.

There are so many opportunities to cheat in it that I would like to know the proper proportions of cement and sand.

When they are faced with richer cement, does it hurt the cement to color the face?

What size is proper for a one-story building, 100x30 feet, and we are going to make it so in the future we can build the second story?

How old ought the blocks to be before they are safe to put in the building.

F. W. D., Lake Crystal, Minn.

The manufacturers of blocks seem to have settled upon proportions of about 4 of sand to 1 of cement as the best for ordinary face blocks. The proportions must be varied somewhat with variations in voids in the sand or gravel used, and about 10 per cent. more cement should be used than enough to fill the voids if there is to be a close approximation to a dense or waterproof block.

All coloring matters added to the mortar seem to affect the strength of the concrete, but, unless the amount is excessive they do not seriously injure the blocks.

It is customary to use 10-inch blocks for walls of this size, as is stated by a correspondent elsewhere in this department. Lateral stability has not had sufficient attention and it seems to the writer that a wall, unsupported by cross walls, of the dimensions given, if two stories in height should have occasional pilasters to aid in resistance to overturning under exceptional conditions, such as

collapse of adjoining building, collapse of floor from overweight or burning, etc.

Blocks should be cured in the yard with frequent sprinkling for ten days or two weeks before putting in wall, and thirty to sixty days is better. Many manufacturers are too anxious to run their product through the yard rapidly and the blocks are not so satisfactory in several ways if put in the wall very soon after making, though in a single-story building there is probably no question that they are strong enough.

CONCRETE FOR FLOOR.

What would make the best mixture for a floor in a creamery? This is a busy time of year for creameries and how soon could they work thereon, as there will be water on the surface continually.

Can a top dressing be added on top of a floor which was put in in spring by chipping same with chisel, say about two inches thick? What proportions would you make same?

WILLIAM RIPLEY,
Mt. Bethel, Pa.

The "Handbook for Cement Users" ($3) recommends for floors a mixture of 1 part Portland cement, 3 parts clean, sharp sand and 5 parts of broken stone passing through a 2-inch ring, and gives instructions for laying floors and walks.

There should be a finishing coat 1-2 to 1 inch thick, according to amount of use of the floor, and this may be made of various proportions from 1 of cement and 1-2 of sand, to 1 of cement and 2 of sand, the mixtures with the larger amount of sand standing the wear of traffic best, and those richest in cement being most nearly impervious to water. The trowel finish usually makes a floor quite impervious. Expansion joints must be provided if there is likely to be considerable change in temperature of the floor.

Such a floor is not ready to use in less than a week after it is fully completed and longer time is desirable. It will be set sufficiently to bear weights in less time but will not stand wear.

The "Handbook" also gives instructions about putting a new top on a floor, with the warning that failure might occur even with the utmost care and the best materials. Perfect cleanliness of the old surface, no dust or loose particles, thorough wetting of the old concrete, and a thin coat or wash of neat Portland cement on the wet surface followed immediately by the new wearing surface coat are given as essentials.

ASPHALT AND OTHER BITUMINOUS SIDEWALKS.

Could you refer me to some book or copy of magazine from which I could get information relating to durability, cost and method of construction of asphalt or tar and gravel sidewalks? I should also like to receive catalogues of machinery necessary for this construction.

L. C. H., Tacoma, Wash.

There are several valuable articles on this subject in MUNICIPAL ENGINEERING. Among the most important are the following:

"Specifications for Bituminous Concrete Sidewalks, Crossings and Gutters." vol. xxi, p. 100. This article gives full specifications and instructions for laying.

"Cost and Life of Sidewalks Materials," vol. xxii, p. 21.

Byrne's "Highway Construction" ($5) devotes eleven pages to this subject.

LIGHTING

Cement Joints for Gas Pipes—Cost of Decatur Light—Municipal Light in Alameda—New York State Lighting Commission.

Cement Joints for Gas Pipes.

By JACOB D. VON MAUR, St. Louis, Mo.

During the past year the Laclede Gas Light Company received notice from the Director of Public Works of the city of St. Louis, to discontinue the use of cement joints in the laying of our gas mains throughout the city, on the ground that these joints would undoubtedly leak in the future, which would necessitate the tearing up of the streets in order to repair the same. As there has never been any objection on the part of the city to the use of lead, it can be assumed that the city officials feel that there is a greater chance of leakage in our gas mains where the joints are made with cement than where they are made with lead. In order to convince the city officials that by using

cement for joint making the leakage would be lessened rather than increased, and that there would, therefore, be less tearing up of the streets to repair such leaks, it was decided to make a thorough investigation of the whole subject, and to that end information was requested from a large number of gas companies throughout the United States, in order to determine what the experience was in other cities.

A circular letter was, therefore, written to all the leading gas companies, being careful to select such companies that the answers, when compiled and tabulated, would represent the average judgment of gas engineers throughout the country. The letter is quoted below in full:

The city authorities of St. Louis recently requested the Laclede Gas Light Company to discontinue the use of cement in making up the joints of gas mains, claiming that the use of cement for this purpose is unsafe and will result in an abnormal number of leaks, which would necessitate the tearing up of the city streets for the purpose of repairing the same. We, of course, hold quite the opposite view to that held by the city, but in order to settle the question once for all, and to the satisfaction of all concerned, we should like to get data from such gas companies as are at present using cement in laying gas mains, and to that end we respectfully ask you to answer the following questions:

1. To what extent are you using cement in the laying of gas mains in your city?
2. How many years have you been using cement?
3. Have leaks in gas mains increased or decreased since you started to use cement for the joints instead of lead?
4. Have any really serious leaks occurred on a cement joint when the work was properly done?
5. Is there any objection on the part of the city authorities to the use of cement for this purpose?
6. Do you make any provision for expansion?
7. In your judgment, assuming that pipes are laid with the minimum cover of four feet and joints properly made with cement, do you think the chances for a leak would be increased or decreased over what they would be had the joints been laid with lead?
8. What brand of cement do you use?

Any information which you desire to impart will be appreciated.

That the importance of the question was appreciated by all is best shown by the number of answers received, there being a total of fifty-two answers out of a total of sixty requests. With a large number of the answers came a request for a copy of the report when the investigation was completed. Our president, Mr. O. O. Thwing, requested the writer to furnish the information to the gas fraternity in the form of a paper, to be read before this association.

A careful survey of the answers as received brings out the following points:

1st. Those answers which are unfavorable to the use of cement come from cities where cement has never been tried very extensively.

2d. There seems to be a prejudice against the use of cement in the business sections of the very large cities.

3d. In a number of cases the cement joint was used to a very limited extent with very good success, yet for some unexplainable reason its use was not continued.

4th. In every case, with one exception, Portland cement was used, and in the exception noted Rosendale cement was used.

5th. There is a difference of opinion as to whether it is necessary to use the foreign or more expensive brands of Portland or domestic cements.

6th. There is a very wide difference of opinion as to whether provision should be made for expansion or not, but in every case where provision was made at all it was done by inserting lead joints at stated intervals.

7th. It seems to be the generally accepted opinion that cement should not be used in soft places or in any place where there is likely to be a settlement of the pipe, or where the pipe is subjected to vibration.

8th. It is very important to note that in almost every case the tests applied to pipe laid with cement joints are many times greater than the tests applied to pipes with lead joints.

9th. In only one case was an objection made by the city officials to the use of cement joints, and this objection was removed as soon as the value of the cement joint was demonstrated, so that at present we have no record of an objection on the part of the city officials to the use of cement in making up joints.

10th. In no case has the leakage increased by the use of cement and in nearly every case the leakage has decreased.

It is my purpose to discuss each one of the above items, but before doing so I will give below full reports of what has been done in St. Louis.

I have not been able able to determine to what extent cement was used by the old company in St. Louis. At various points where we excavated we found cement joints. On several lines on which cement was used the joints leaked very badly, notably the 16-inch high pressure line leading from Station A to Station G. That these joints were not made properly was evidenced by the fact that in many cases we found the yarn sticking out of the joint, near the bottom of the bell, and I feel sure that wherever a leak has been found the cause was due to a joint being improperly made.

This company commenced laying its mains with cement last May and has laid an increasing number of feet with cement joints each month since that time, until now all lines are laid with cement. Better than any discussion I could give will be special reports on work actually done. Starting with the size 4-inch—the smallest we lay—I give below in full reports of work done:

First.—A report of test made to determine at what pressure a 4-inch cement joint, properly made, will leak, and to ascertain whether such joints will leak when they are subjected to a settlement of the pipe.

I beg leave to submit to you the following report on the special test made upon four lengths of 4-inch pipe. The joints were five in number and the material mixed in the following proportions: Cement, 2 quarts; water, 1 1-3 pints. These joints were allowed to set for thirty-six hours and then a trial pressure of 60 pounds was put on, which was gradually increased until we reached the limit of the engine, viz.: 125 pounds per square inch. This pressure was allowed to remain for thirty minutes, without any apparent variation in the gauge. The joints were also tested with soapsuds every five minutes to see if any leaks could be detected. In order to see if a cement joint contained any elasticity, a man was placed in the middle of the line, and after the center blocking was removed, danced up and down on it, causing it to fluctuate from 6 inches to 8 inches each way, and even at this very high pressure and undue strain no leaks were found, neither was the cement disturbed in any manner. The blocking was then taken away from the ends and the plug and the cap left free of support, in order to see if the high pressure would move them out of place, but no motion was seen. The pressure was then reduced to 15 pounds per square inch. In order to ascertain the amount of give or play a cement joint would allow, we subjected the line to the following harsh test or treatment. The two ends were gradually elevated until they were 25 inches above the ground level, then the center blocking was removed and the pipe allowed to sag in the middle. It was found that the sag amounted to 12 inches. In order to find the point of fracture in the facing of the joints, the pipe was gradually weighted down until at a sag of 15 inches a slight leak in the bottom was discovered where the cement began to lose amalgamation with the iron. Additional weights were placed upon it until the pipe reached the ground, which sag amounted to 24 5-8 inches, as per sketch. The facing then cracked in several places. The process was then reversed, the two ends being left free, the block being placed in the middle. It was found that when the curve was reversed the leak in the bottom stopped and for a while the joint was tight again. This reversed process was continued until the center was at a height of 28 inches from the ground. The free ends were then swinging in the air, and, in order to keep them on the ground, weights were placed upon them. There was only one joint that was in any visible way disturbed during the whole test, and that was the center one. As a final touch the whole four lengths were again blocked up to a height of 24 inches and then pushed off and allowed to drop the entire distance to the ground, and even after this shock no fractures were apparent in the joints.

Second.—Test of Lucky street, 6-inch main.

I beg leave to submit the following report, complying with the letter of the superintendent of the street department in regard to a special test, in order to see if cement joints could withstand a pressure of 50 pounds. We took three lengths of 6-inch pipe, a plug and a cap, in all four joints, and used "Star" cement in the following proportions:

Joints.	Cement.	Water.
1.....	2 quarts.	1 1-2 pints.
2.....	2 quarts.	1 1-2 pints.
3.....	2 quarts.	1 5-8 pints.
4.....	2 quarts.	1 2-3 pints

with 1-4 gill of muriate of ammonia.

The last solution was made as an experiment to see what the effect of the ammonia salt would be on the joint, and its action upon the cement. These four joints were thoroughly caulked and rammed, and after being allowed to set for forty hours were then subjected to a pressure of 24 pounds, and this was gradually increased until the gauge stood at 100 pounds, which pressure was maintained for half an hour. The joints were thoroughly inspected and tested while the pressure was being applied, and even at this high figure no perceptible leak was discovered nor was a variation of the gauge visible. The pressure was not increased beyond this figure for fear of an accident happening, due to the enormous pressure.

Third.—Test of Old Manchester road, 6-inch main.

As you requested, I put 165 feet of 6-inch pipe together for an experimental test. The test was made in the following manner: A 10-pound pressure was put on, then each joint examined carefully; after that 5 pounds at a time, each time thoroughly tested until we had 50 pounds pressure, which was all the pump would supply, and still no leak. Five ounces of yarn were used to a joint, 9 or 10 strands to the first yarn, which was driven back solid. The joint was then filled and a second yarn of 11 or 12 strands put in and driven hard. The joint was then faced with a thin layer of cement. The cement used for this test was "Red Ring," and was mixed 1 1-2 quarts of cement to 1 pint of water; the cement then set 72 hours before it was tested.

Fourth.—Report from Washington University.

Six-inch pipe with lead joint was tested at Washington University in order to determine at what pressure the lead would give way. The following are the results: At 13,900 pounds pressure the lead moved; at 24,700 pounds pressure the iron broke. With a cement joint: At 29,450 pounds the cement cracked on the outside; at 32,000 pounds the iron broke. Holes were drilled into the 6-inch pipe to facilitate making the test of the joints, so that the tension at which pipe broke does not represent the total tensile strength of the iron. The test is given simply to show the relative strength of lead and cement joints.

Fifth.—Vandeventer avenue main.

One thousand feet of 10-inch was laid with cement joints and tested to 50 pounds, without showing any leak. The soil was saturated with water.

Sixth.—Sarah street, 12-inch line running from Sarah to Easton.

The following are details of a test which was put on the new pressure 12-inch line on Sarah street:

The section of pipe tested consists of nineteen lengths of standard 12-inch pipe, joined together with cement. The joints—twenty in all—including the end which was plugged—were cement. On Friday, September 16, 1904, and twenty-four hours after the last joint was made, a test pressure of 10 pounds to the square inch was put on the line with the result that all the cement joints, with the exception of two, showed no sign of a leak. The two which did leak were made by a new man, which probably accounts for their not holding as well as they should have.

Seventh.—Osceola street, 16-inch pipe.

A test was made of the joints on the 16-inch main on Osceola street, between Broadway and Minnesota, with a pressure of 4 1-2 pounds. Ninety-three cement and eighteen lead joints were tested. The pressure was on for one hour, during which time it lost only one-tenth of an inch. This was due to leaks in plugs at either end of the line, the joints of which were made of plaster of paris.

Eighth.—Lynch street, 20-inch pipe.

Yesterday a test was made on a section of the new 20-inch main on Lynch street. There were thirty-six lengths of pipe with 16 lead and 21 cement joints. The test lasted one and one-half hours and not a joint leaked under a pressure of 12 pounds.

Ninth.—24-inch, high-pressure main, on Lucky street.

I beg leave to submit the following report concerning the cement joint tests made on the 24-inch high pressure line on Lucky street. The brand of cement used is known as "Star," and the following operation and proportions were used: The bell and spigot of each pipe were thoroughly washed and cleaned of all foreign material and then placed home. A grouted yarn of six strands was thoroughly caulked into place, after which was placed cement of the following proportions: Cement, 5 quarts; water, 1 1-2 quarts plus 1 gill. This amount of cement is sufficient to finish the entire joint, which includes filling and facing. After the cement batter is placed in the joint, by hand, a caulking tool of the third size is used and the cement then thoroughly rammed. A second yarn of 7 strands is then put in dry and driven back with the same caulking tool and a hammer. The joint is then faced. The whole job, consisting of fifteen joints, including the cap and plug, after setting twenty-seven hours, was subjected to a test of 10 pounds of air and the joints all examined and tested with soapsuds. As everything was found to be in perfect condition, the pressure was gradually raised to 25 pounds and maintained at this figure for one hour, without any visible sign of a leak or variation in the gauge reading. Since this test was made we have found it necessary to use 8 quarts of cement to 2 quarts plus 1-2 pint water. This additional amount is due to larger joints and hard driving of the cement. On one of our tests a few joints were seen to "sweat" at 15 pounds. In order to see if "patching" would be feasible in this case a trial was made, but it was found a flat failure.

Tenth.—24-inch, high-pressure on Lucky street.

I beg leave to submit the following report concerning the test on the 24-inch, high pressure main on Lucky street. There were in all fifty-six cement joints, and the cement used was of three different grades, viz.: "Star," "Red Wing" and "Dyckerhoff." It was noticed that the last named brand took about 1-2 pint more water to the customary 8 quarts of cement than we are accustomed to use; otherwise, the standard proportions as already reported were used. These joints were allowed to set for forty hours, and then a test of 15 pounds was applied and the line was found to be tight, without a single leak or sweat.

Eleventh.—24-inch, high pressure main, on Magazine street.

I beg to submit the following report concerning the test on the 24-inch high pressure line on Magazine street and Webster avenue. There were in all sixty cement joints mixed in the following proportions: Cement, 8 1-2 quarts; water, 2 quarts plus 3 1-2 gills. After these joints had been allowed to set for thirty-six hours we applied a test of 20 pounds per square inch and found the line tight in every respect. The brand of cement used is known as "Red Ring."

Twelfth.—On Broadway, thirty-one lengths of 30-inch pipe were tested to a pressure of 30 pounds, the gauge being allowed to stand two hours without showing any drop. The joints were also tested with soap suds and no leaks were found. The cement used was the "Star" cement. A test was made of eighty-eight cement and twenty lead joints on the 16-inch main on Osceola street, between Minnesota and Virginia avenues, with a pressure of 10 pounds. The pressure was left on for one hour and forty minutes, during which time each joint was tested with soap and water. At the expiration of the time the gauge still registered the full 10 pounds. The following day, after the 16-inch main on Osceola street had been connected to the main which Nicholson is laying on Virginia avenue, a 5-pound pressure was put on both lines. The gauge again remained stationary, not varying in the slightest degree. The pressure was left on for one hour.

A test of 4-inch cement joints, which had been made when the thermometer registered 31 deg. Fahr., was made to see what effect freezing weather would have upon the cement. Ten lengths of pipe were laid for the test and the joints made with "Star" cement. In every case the water used in mixing the cement had been slightly warmed. Immediately upon the completion of every joint, it was wrapped with a sack and covered with a layer of dirt about 8 inches deep. After a 40-hour set (from Saturday afternoon until Monday morning) an air pressure of 10 pounds was put on the joints, which were then tested with soapsuds for leaks.

The pressure was then raised to 20 pounds and the joints were again tested with soapsuds. In neither case was there a leak found. The pressure was again raised, this time to 30 pounds. When this pressure had been on an hour a final test was made with soapsuds, and again no leaks were found. The results of this test would warrant the statement that cement joints are not affected by moderately cold weather.

It will be noted that these are reports of actual tests made by various foremen and street clerks throughout the city, and the reports are given verbatim. The last seven tests were made in order to determine whether it was safe to make joints in freezing weather. Under ordinary conditions, if proper care is used, it would appear from these few experiments that it is perfectly safe to make cement joints when the thermometer registers as low as the freezing point.

Now, referring to the ten points above stated, the answers received which were unfavorable to the use of cement came from cities where cement had never been tried very extensively. Of the reports from fifty-two cities only ten used cement entirely and nineteen almost entirely, whereas twenty-three do not use cement. In view of the favorable results obtained in twenty-nine cities, together with the experience in St. Louis, as shown in the various tables and experiments, it does seem that the great saving and advantages to be gained by using cement joints are not fully appreciated. Table No. 1 shows the saving in money, per mile of pipe laid, for each size.

Another great advantage is the fact that a cement joint offers more resistance for the passage of electric current than a lead joint does. Mr. E. E. Brownell, in his "Electrolytic Survey of the City of St. Louis," cites an example of a 6-inch main 100 feet long, which being tested, shows a resistance of 12,000 ohms.

In order to get some idea as to the relative resistance of the various kinds of joints, an experiment was made in St. Louis by making up four short pieces of 4-inch, cast iron pipe. The first two joints were made with an asbestos gasket in the back of the bell to prevent the spigot from touching the bell. The joints were made with cement in the usual manner. The third joint was an ordinary cement joint without the asbestos gasket. while the fourth joint was made of lead in the usual manner. A report of the test is shown below:

Joint No. 1, of asbestos and cement, shows a resistance of 18.2 ohms; No. 2, of asbestos and cement, shows a resistance of 19.18 ohms; No. 3, of cement, shows a resistance of 17.64; No. 4, of lead, shows resistance of .000385 ohms.

This test certainly shows that a cement joint has a great advantage over a lead joint from a purely electrolytic standpoint. The third advantage is the fact that the work can be done with unskilled labor, and, fourth, a cement joint is less liable to leakage than a lead joint. This latter I consider the greatest advantage of all.

Second Item.—There seems to be a prejudice against the use of cement in the business sections of the very large cities. I am unable to account for this prejudice, because my experience with lead joints, both in St. Louis and other cities, has been that the largest number of broken mains has occurred in the business section of the city and were laid with lead joints. Last year we had over 100 broken gas mains, over 75 per cent. of which were made with lead. We have no records showing any broken mains where the joints were made with cement, although there are a great many miles of such mains in St. Louis, which have been laid for a great many years. Last year we laid sixty miles of pipe with cement joints and thirty miles with lead joints, but at this writing we have had only one slight leak on the entire amount of pipe laid.

TABLE 1.—SHOWING COST OF CEMENT AND LEAD JOINTS AND SAVING PER JOINT IN CEMENT OVER LEAD.

Size of joint. Inches.	CEMENT JOINTS.				LEAD JOINTS.				
	Cement.	Yarn.	Labor.	Total.	Lead.	Yarn.	Labor.	Total.	Saving per joint in cement over lead.
4	.02	.012	.040	.072	.375	.008	.075	.458	.386
6	.03	.020	.065	.115	.600	.010	.100	.710	.595
8	.04	.025	.100	.165	.750	.015	.125	.890	.725
10	.05	.030	.135	.215	.950	.020	.150	1.120	.905
12	.06	.037	.170	.267	1.150	.030	.200	1.380	1.113
16	.08	.050	.200	.330	1.500	.030	.300	1.830	1.500
20	.10	.057	.300	.457	1.875	.037	.400	2.355	1.898
24	.13	.068	.440	.638	3.000	.044	.660	3.704	3.066
30	.14	.085	.550	.775	3.600	.054	.830	4.485	3.710

Amount of lead used in this table is calculated from standard dimensions of pipe and should be the minimum amount used. Table No. 2 is based on actual amounts used in St. Louis.

These quantities are actual, as used in St. Louis, Mo., giving good results.

Proportion of water to cement should be in ratio of about 1 to 4.

Actual quantities will vary according to size of bell.

The writer claims that if a main is properly laid with four feet of cover, and so as to have an even bearing, there will be less likelihood of a leak or a break with cement than if lead is used; and it is our intention during the coming season to use cement joints in the business section of St. Louis as well as in the suburban part of the city.

Fourth and Fifth Items.—Regarding

TABLE No. 2.—OF APPROXIMATE QUANTITIES FOR CEMENT AND LEAD JOINTS.

Size of Pipe	Cement Joints				Lead Joints	
	Cement in Quarts	Cement in Pounds	Water in Pints	Yarn in Ounces	Pounds of Lead	Yarn in Ounces
4″	1 to 1½	2.25 to 4.10	⅓ to 1⅕	4	7½	2½
6″	1½ to 2	4.10 to 5.50	1¼ to 1⅝	6	10	3½
8″	2 to 2½	5.50 to 6.87	1¼ to 1½	8	15	5
10″	2½ to 3	6.87 to 8.25	1½ to 2	10	19	7
12″	3 to 4	8.25 to 11	2 to 2½	12	23	9
16″	4 to 5	11 to 13¾	2¼ to 2½	15	30	9
20″	5 to 6	13.75 to 16.50	2½ to 3½	20	37½	10
24″	8 to 8½	20 to 23.38	5 to 5½	27	60	16
30″	7 to 7½	19.25 to 20.62	4 to 4½	27	72	17

the kind of cement to be used, our experience as well as that of other cities shows it is immaterial what brand is used. Any good American Portland cement will give good results, and as it is cheaper to use the domestic than foreign brands there is no good reason for using the latter. Rosendale cement may give good results, but it is considered good engineering to always use Portland cement below the surface of the ground, and as the difference in cost is trifling, I can see no advantage in using the Rosendale.

Sixth Item.—Referring to provision for expansion. I agree thoroughly with Mr. Forstall, of Philadelphia, that it is not necessary to provide for expansion. A survey of the answers will show that lead joints are inserted every fourth or fifth joint in some cities and one lead joint to the block in others. Surely if one lead joint to the block is sufficient, then one lead joint in every fifth or sixth joint is more than sufficient. It would be interesting to have some of the members explain just why they insert the exact number of joints which they do, as there must be some reason for so doing. Frost in St. Louis last winter reached a depth of 3 feet to 3 feet 6 inches.

Our experience, of course, is all based on four feet of cover, and it may be that if the pipes are laid with a less cover it would be necessary to make some provision for expansion. Two years ago we laid some ten miles of 3-inch wrought iron pipe in cement and pitch and made no provision for expansion. This pipe is under a constant pressure of 250 pounds

TABLE NO. 3.—SHOWING APPROXIMATE SAVING PER MILE OF MAIN.

Size.	Saving per Mile.
4 Inches	$170.00
6 "	218.00
8 "	319.00
10 "	398.00
12 "	490.00
16 "	660.00
20 "	834.00
24 "	1,249.00
30 "	1,632.00

to the square inch, and yet has never shown any leaks at the joints.

Seventh Item.—It seems the generally accepted opinion that cement should not be laid in soft places, the idea being that the pipe might settle, and on account of the rigidity of a cement joint leaks would develop more readily than with lead joints. In the face of experiment No. 1 it would seem that there is a great deal more elasticity in a pipe line laid with cement joints than has been generally supposed. I should not hesitate to use cement under any conditions where I would be willing to lay a gas pipe. If the ground is so soft as to make it dangerous to use cement joints, I should certainly make provision to get a good foundation before laying the pipe, no matter what kind of joint was used.

Eighth Item.—Regarding the high pressure under which cement joints are usually tested, I believe that this is done more as a precaution than from any real need. According to the nature of cement it is necessary, in order to develop its full strength, for it to set at least seven days. Since this is impracticable in pipe laying, tests are usually made within twenty-four hours. I would, therefore, be in favor of applying a test of a few

pounds on ordinary low pressure work rather than put on a test of from 30 to 50 pounds, which seems to me a useless expenditure of money after it has once been determined that a cement joint properly made will remain tight. Items 9 and 10 are self-explanatory.

It is hoped that the detailed information contained in this paper will be of assistance to those who have not had experience in making joints of cement, but it is well to bear in mind that the essential and all important principle in laying any gas main is that the main must be laid on a solid foundation. Too much has been written regarding joint making—too little regarding the foundation. Without having the foundation it is useless to try and make a tight pipe.

New York State Lighting Commission.

The State lighting commission bill has been signed by Governor Higgins, of New York, and goes into effect immediately. The bill fixes the price of gas furnished to the city of New York for municipal purposes at 75 cents per 1,000 cubic feet, and the price of electric light furnished to private consumers in New York City at 10 cents per kilowatt hour. The price of electric light furnished in New York City for municipal purposes is fixed at 10 cents per kilowatt hour, except that 12 cents may be charged in Brooklyn; electric street lamps consuming 450 watts, $100 per year; consuming 325 watts, $90; where two electric street lamps are attached to one pole, $65, per lamp. The bill authorizes the Governor to appoint a State commission of gas and electricity of three members. The commission will have supervision of the gas and electric lighting, heat and power companies, and may fix the standard of gas furnished, as well as to establish the standard pressure at which gas shall be delivered. The books of the corporations may be examined by the commission and comprehensive reports are to be filed by the corporations, which hereafter cannot be organized except with the consent of the commission.

Cost of Municipal Lighting in Alameda, Cal.

The report of the municipal lighting works of Alameda for February, as given in *Pacific Municipalities*, is an instructive one as showing the cost of street lighting under municipal operation. In the report given below it will be noted that the cost of operation includes the cost of permanent construction, which should be excluded from operating expenses. It will be further noted that interest and depreciation charges are included. The statement, therefore, is a fair one, to say the least. The cost for each arc light for the month was $2.63. Inasmuch as most cities pay from $6 to $8 a month for each light, it will be seen that the saving is considerable. The following is the report:

EXPENDITURES.

Construction—Labor	$58.50
Meters, pole wire, new well, etc.	373.88
Salaries and labor	1,186.75
Fuel oil	546.00
Oil and waste	67.40
Repairs	67.76
Carbons	12.93
Lamps	17.95
Horse board	72.00
Bicycle	40.00
Insurance	138.60
Interest on bonds	31.25
Depreciation	583.33
Miscellaneous	214.40
Total	$2,978.37

EARNINGS.

Commercial lighting	$2,152.35
Commercial power	66.80
Miscellaneous	118.05
Total	$2,338.20
Total expense	$2,978.37
Total earnings	2,338.20
Cost to city for public lighting	$640.17

Meters connected, 26; meters disconnected, 11; consumers gained, 15; due creditors, March 1, $1,814.02; due from consumers, March 1, $884.05; collections for the month, $2,551.65; balance in electric light fund, March 1, $3,503.90.

COMPARATIVE STATEMENT.

February, 1904—Earnings from commercial lighting, $1,483.25; fuel oil consumed, 746 bbls.; street lights burned, 146 hours; number of arc lamps or their equivalent burning, 212.

February, 1905—Earnings from commercial lighting, $2,220.15; fuel oil consumed, 840 bbls.; street lights burned, 116 hours; number of arc lamps or their equivalent burning, 243.

Cost of Decatur, Ill., Lights.

Comptroller Robbins has prepared some figures of interest regarding the cost of operating the municipal lighting plant of Decatur, Ill. The items charged to the light account are:

Payroll down town	$3,560
Payroll at power plant	1,740
Coal	1,466
Carbons	653
New armature	488
Globes	101
Belting	53
Electrican to convention	50
Mayor and electrican to Chicago	8
Lamp repairs, etc	30
Total for the year	$8,149

The city had 250 lamps in use. That is at the rate of $32.60 a lamp a year. At the comptroller's office they call it $33 in round numbers. Last year the lamps burned 2,322 hours.

The downtown payroll includes the city electrician and three assistants. They take care of the lamps, trim them and look after line work when necessary. The payroll at the power plant includes one engineer and one fireman. The amount of coal used for light is determined by Engineer Fred Litterer and is made up from the total of his monthly reports.

The above figures include nothing for interest on the investment, and there is no charge for plant deterioration, though this time the new armature was charged. On the city's books the plant is carried at a valuation of $35,000. The first plant installed cost $18,000, and in that were eight light towers, now back numbers, but still in use. The total of $35,000 is reached by adding to the first cost everything that has since been added to the plant. The plant has been in operation since 1886, nineteen years.

WATER PURIFICATION

Copper Sulphate—Water Purification—Water Power Project for Chattanooga—Columbus Filtration Bid.

The Use of Copper Sulphate in Purifying Water at Anderson, Ind.

From Bulletin No. 76, U. S. Department of Agriculture.

By the invitation of Mr. C. Arthur Brown, sanitary engineer of the American Steel and Wire Company, acting at the time as the representative of the Jewel Filtration Company, and through the courtesy of the officials of Anderson, Ind., the Laboratory of Plant Physiology was enabled to undertake a series of experiments upon the effect of copper treatment of water in connection with mechanical filtration. The filter plant had been recently completed, and these experiments were carried on at the time of the preliminary testing of the efficiency of the filters.(a) The water supply at Anderson, Ind., offered exceptional opportunities for demonstrating the efficiency of copper in rmoving intestinal bacteria. The water is drawn from the White river, into which the city of Muncie empties its entire sewage. There are no falls or rapids in the twenty-five miles separating these two cities, and during the entire four weeks of the test conducted on the use of copper in connection with filtration the river was ice-bound, making a closed conduit for the diluted sewage from Muncie and the smaller towns still farther up the river. The water was very high in albuminoid and free ammonia, and exceptionally high in chlorine, due to the salt water from the gas field above Muncie. The turbidity was very low and the color slight. Fortunately for the thorough testing of the value of copper, the filters, owing to some structural defects, were unable to effect a high percentage reduction of bacteria at this time. The number of bacteria in the river ranged from 13,000 to 155,000 per cubic centimeter at irregular intervals during the four weeks' test, usually remaining above 50,000. The number of bacteria in the filtered water varied between 15,000 and 400 per cubic centimeter, usually remaining above 3,000.

For ten days, February 2-11, 1900, alum was used as a coagulant, but for water of this character it seemed impossible to get a proper coagulation with one, two or three grains of alum per gallon, either with or without the addition of lime. Bacillus coli was always present in the river water, and usually in the filtered water, and was identified by gas formation, reduction of neutral red, proportion of carbon dioxide, growth on milk, potato, gelatine, litmus agar, and formation of indol. On February 11, instead of aluminum sulphate, iron sulphate containing 1 per cent. of copper sulphate was introduced in quantities of 1½ grains

(a) Professor Burrage, professor of sanitary science at Purdue University, was retained by the city of Anderson as its representative, as well as Dr. S. C. Norris, city chemist and bacteriologist. Mr. Brown acted as the representative of the filtration company.

per gallon of water.(*b*) Lime was added, two grains per gallon. The treatment was continued four days, and during that time only once was there any indication of the presence of B. coli in fermentation tubes inoculated with 1 c. c. samples of filtered water, and this occurred immediately after a leak developed in the air pipe of the washing system that allowed unfiltered water to pass into the pipes. On the 15th of February the amount of iron sulphate containing 1 per cent. of copper sulphate was raised to 4½ grains per gallon. This quantity was found to be too great, and at midnight the amount of the coagulant was reduced to 2¼ grains.(*c*) The valve controlilng the iron solution caught on this change, and for nearly an hour no iron or copper was applied to the raw water. This allowed polluted water to reach the clear well, and at the next washing the filters were again contaminated, and samples from two of them developed typical bacillus coli. The following five days B. coli developed but once, and this was immediately following the reappearance of the leak in the air pipe.

Iron sulphate containing one-half per cent. copper sulphate was now applied at the rate of 1.5 grains(*d*) per gallon; bacillus coli was eliminated during the two days that this mixture was used. Iron sulphate containing only one-fourth per cent. copper sulphate(*e*) was substituted during one day. This amount was insufficient to eradicate completely the B. coli, and two of the filter samples contained this organism.

Pure iron sulphate was then used at the rate of three grains per gallon, and bacillus coli developed from samples of each filter. Iron sulphate containing 1 per cent. copper sulphate was substituted for the greater part of the pure iron salt, and in the following samples no B. coli developed in the filtered water.

From the preceding experiments there seems to be no doubt that the filtering of polluted water of this character through the layer of coagulum of iron and copper which forms on the filter bed brings the bacteria borne in the water into contact with the precipitated copper for a sufficient length of time to destroy bacillus coli, and as bacillus typhi is still more sensitive to the action of copper, it, too, must necessarily be removed from the filtered water.

The last samples of the test have been omitted from previous discussion, as the point illustrated by them is of an entirely separate character. Shortly before these samples were taken, ten gallons of a bouillon culture of bacillus prodigiosus were introduced into the feed pipe of the filters, and the following and last samples all showed bacillus coli present. This emphasizes the fact brought out in a former bulletin(*f*) that the toxicity of copper sulphate is greatly reduced if the amount of organic and albuminoid matter is greatly increased. A proper comprehension of the constitution of a water is therefore necessary for successfully treating to remove bacteria, just as it is desirable for treating to remove algæ.

It should be reiterated that the results of investigators with reference to the germicidal action of copper in bouillon, milk or solid media are not comparable to results upon the toxic action of copper in water of ordinary purity. Nor can results obtained with unknown organisms, nor results obtained with bacillus anthracis, bacillus tetanus and such spore-forming resistant bacteria be compared with results obtained with bacillus typhi and microspira comma.

One of the objections to the use of copper sulphate in water supplies has been that there was a chance of appreciable amounts of copper reaching the consumer. Considering the harmlessness of copper, this is a theoretical rather than a practical objection, and is answered in the present instance. The copper is all precipitated and the insoluble coagulum of iron and copper is caught upon the filters.

(*b*) 0.015 grain copper sulphate per gallon—approximately 1 part of copper sulphate to 4,000,000 parts of water.

(*c*) 0.0225 grain copper sulphate per gallon—approximately 1 part of copper sulphate to 2,500,000 parts of water.

(*d*) 0.0075 grain copper sulphate per gallon—approximately 1 part of copper sulphate to 8,000,000 parts of water.

(*e*) 0.00375 grain copper sulphate per gallon—approximately 1 part of copper sulphate to 15,000,000 parts of water.

(*f*) Bulletin No. 64, Bureau of Plant Industry, p. 29.

Great Water-Power Project for Chattanooga.

Work on the great power plant to be erected at the "Suck," on the Tennessee river, by the Chattanooga-Tennessee River Power Company, will begin soon. Next to Niagara, this will be the largest water power plant in America, and the first in the erection of which the government takes a leading part. Under favorable circumstances the plant will be completed within twelve months, and at the farthest Chattanooga will, it is believed, be securing its power from the Tennessee river within two years. The lock and dam will be constructed according to plans furnished by the government engineer, and, this work being a part of the general plan for the improvement of the river, the lock and dam will be con-

structed under the supervision of some government engineer, probably Major Newcomer, who now has charge of the work on the river. The power plant will have a minimum continuous current of 36,000-horse power, furnishing enough electricity to operate all the factories of the city and many new enterprises.

According to the estimates of the government engineers, the dam and lock will cost $1,180,000. The dam will be built of cement, and will be 57 feet at the base, 9 feet at the top, and 35 feet in height. At the exact point where the plant will be erected the river is 1,250 feet wide. The lock will be located on the South Pittsburg bank of the river. The gates of the lock, which will be furnished by the government, will cost $150,000. The power plant will be located on the east side of the river, and will be 60 by 300 feet in dimensions and 57 feet in height. Power to the twelve immense motors will be furnished by thirty-six turbines. The motors will stand on top of the shafts and will be especially constructed for the use of the plant.

The citizens of Chattanooga realized, more than fifteen years ago, the vast power now being wasted at the "Suck," and suggested the construction of a great power plant, such as will now be constructed. Owing to failure to secure capital the plans never materialized. In 1900 Major Dan C. Kingman, then in charge of the Tennessee river improvements, rendered a report showing how the plant could be built and the river improved at the same time. The history of the present movement dates from this report. In January, 1904, a bill was introduced in Congress by Judge Moon providing for the erection of the plant, and this was signed April 26, 1904. The bill provided that the city of Chattanooga be granted the right to build the dam and operate the power plant, if it should take advantage of the clause within four months, and give a bond of $100,000 to complete the work. The city failed to do this, and the right was then vested in C. E. James, J. C. Guild and associates.

We are indebted to C. W. Olson, president of the Chattanooga Chamber of Commerce, for the above information.

A Weighty Bid.

The first bid received for the construction of a filtration plant at Columbus, Ohio, June 12, weighed eight pounds. The bid was submitted by the Norwood Engineering Company, of Florence, Mass.

PAVEMENTS

Brick Pavements for Small Cities—Road Maintenance in Massachusetts—Grade Crossings in Cleveland—Railway Paves Between Tracks—Notice of Ordinance Necessary—Track Elevation at Indianapolis.

Brick Pavements for Small Cities.

The following extracts from a paper by W. E. Gunn, C. E., of Covington, Ky., will be of interest to many of our readers and may give rise to some discussion by those who do not agree exactly with his views:

In the selection of material for the improvement of city streets no fixed rule can be laid down that one kind of material is the best that can be obtained, superior to all others. Such a statement would be mere prejudice. Many subjects bearing on the construction of each street must be considered. The size of the city, the present and probable future travel on the street, the grades that must be encountered, the class of property along the thoroughfare, the relative cost of different materials in that particular locality—each of these has its bearing.

In a fine residence district of a large city, where the matter of cost, and cost of cleaning, would have little weight, compared to securing a noiseless street suitable for fast driving, creosoted wood block or asphalt might be well considered the best selection.

In a park, or for a lightly traveled suburban street, macadam or gravel could be regarded as equally suitable.

In like manner, a street in a manufacturing district, subject to severe travel, could be best taken care of with granite paving, while the ideal path for the sport of kings, is natural soil, as illustrated at Morris Park, Hawthorn, Saratoga or Latonia.

Each material has its advocates and its arguments, its real advantages and disadvantages—its own field of use.

In cities of medium size, brick streets, for economy and general utility, are better adapted than any other material. Such cities, say from 15,000 to 150,000 in population, as a rule, are not extremely wealthy and do not have the most severe travel to provide for. They must therefore select a material of sufficient strength and durability for the local needs, and take careful thought of the first cost of the material, as well as the cost of cleaning and repairing. The principal streets of such towns, if left in the macadam with which they have usually been paved first, become an expensive nuisance, intolerably dusty in the summer and unspeakably muddy in wet weather.

Street reconstruction becomes a necessity.

As to first cost brick paving may be estimated at $1.75 per square yard, including cost of concrete foundation. Asphalt will cost perhaps one-third more. After the period of guarantee has expired, the asphalt street will cost during the remainder of its life from five to ten times as much to repair as a brick street. The local experience has been that the livery stable owners, teamsters, and all persons interested in constant use of the streets for hauling, prefer brick streets to asphalt.

A serious objection to the use of asphalt is the fact that a city of medium size can not afford the expense of maintaining its own plant for making repairs. Almost any city can find home labor sufficiently skilled for making all necessary repairs for a brick street, which is a desirable feature in the use of brick, and the fact that home labor can not repair asphalt is an objection to its use.

The material for brick paving can readily be examined and inspected to prevent the introduction of brick inferior to the requirements of the specifications and contract. The inspection of asphalt is much more difficult; it is the work of a specialist.

A further argument for the use of brick is its durability. The life of a brick street, before it needs repairing, is certainly of greater length than asphalt.

Creosoted wood block paving promises a superior street, but its cost, which is about two-thirds more than brick, prevents its use from becoming general at the present time.

In stating that brick is most suitable for medium-sized cities, I do not mean that it should not be used in villages and large cities, but that its judicious use is proportionately greater in cities of medium size.

Assuming that brick has been adopted as the material to be used, let us examine what is at present good practice in laying brick pavements. At the present time, the brick generally used are 3 inches wide by 4 inches deep by 8 inches long. The foundation of the street is composed of about six inches of concrete. On this is placed a sand cushion of 1 1-2 to 2 inches. The brick, after being laid in place, are rolled to a true surface, which produces a very much smoother and more perfectly formed street than was formerly secured by ramming. The street is then completed by filling the joints with a rich grout composed of equal parts of Portland cement and fine sand. At intervals of about 25 feet, three or four joints are filled with tar to provide for expansion. It is possible that the joints could be more perfectly filled by brushing the mixture of fine sand and cement into the joints dry instead of in the form of grout. The use of cement instead of tar is a very material improvement. When the joints are thus filled, the paving acts as one piece. The street remains smoother and this decreases the noise, and is bound to add to the durability of the paving. A tar filler at certain times of the year becomes soft. Each brick can then go down separately. The paving becomes, to some degree, rough and therefore more liable to wear.

All tracks for street railway service should be laid with six inches of concrete under the ties. The use of grooved girder rails makes the least objectionable track for street purposes.

It is customary to limit the absorption of brick in specifications for street building to 2 per cent. This requires the use of a shale brick, and while the writer's experience favors this kind of material, the 2 per cent. limit is rather narrow. There is no connection between absorption and the ability of brick to stand an abrasion test unless the absorption is more than 2 1-2 or 3 per cent.

The best wear of brick in the street is not confined to brick that absorbs less than 2 per cent., although some of the best wearing brick are within the limit.

In order to secure the most satisfactory results in street building, it is very important to have all sewer, gas and water pipes laid before the street is built. It is almost impossible to repair the surface with its original perfection if cut open after completion. Medium sized contracts usually secure better competition and more advantageous prices than very large or very small contracts. All material and work should be guaranteed for sufficient

length of time to demonstrate its good quality.

A most important feature of securing an attractive street is to build good and uniform sidewalks at the same time.

Streets carefully built and honestly inspected, as outlined above, will give good results in use, and will add to the value of the adjoining property. Their cost is reasonable, and they will give satisfaction to the citizens.

Road Maintenance in Massachusetts.

The following extracts from a recent report of the Massachusetts Highway Commission show the work done in repair of the roads built under the Commission. They show the economy to the state of its road rollers. The state is also seen to have begun the use of reinforced concrete bridges and culverts.

The law of 1900 requires a payment to the comomnwealth by each municipality in which state roads are built of the cost of maintenance of such roads, but not exceeding $50 for each mile of state road in the respective municipalities. The total cost of repairs was $55,082.53 in 1903. There will be paid back into the state treasury the sum of $18,750.71, or about 34.04 per cent. of the total cost.

The same general scheme of repairs as reported for previous years has been continued during the present year. As the state roads are increased to such a length as to make it economical, the maintenance is let out to contract. This is by far the cheapest way of conducting the work. One of the commissioners or an engineer looks over all the roads at short intervals of time, and such close inspection as is made insures good, honest care by the contractor. Eight contracts of this kind are now in operation, covering 64.17 miles. Where no contract exists the repairs are made under the direction of a division engineer, either by day work or at a stipulated unit price. Parts of the macadam roads in Charlemont, Northampton, Deerfield, Buckland, Phillipston, Westport, Fairhaven, Mattapoisett, Leicester, Spencer, Andover, Methuen, Russell, Huntington, Worcester and Paxton were thoroughly resurfaced and repaired during the current year. The length thus repaired was 12.7 miles. At various points on the Andover, Leicester, Charlemont and Shrewsbury roads the frost action was such as to cause blowholes or ruts. These weak places were removed by building side drains just outside the edge of the macadam, or by stripping off the macadam surfacing, removing clayed soil from the sub-grade, placing "V" drains and replacing the old broken stone. There were 3,096 feet of side drains put in at a cost of $766.18, and 698 feet of "V" drains at a cost of $506.03.

This work might well have been done when the roads were built, but the treacherous character of the soil in these spots was not easily discoverable at that time. In the opinion of the commission, it is more economical to take the chances on certain doubtful soils, remedying the defects which may develop later, and by so doing save useless work.

The resurfacing of these roads was made necessary by the wearing away of the broken stone under the traffic. The amount of this wear is dependent upon the quality of the stone and the character of the traffic. Trap rock is used for resurfacing in all cases where its cost is not too great, and it was used on these roads except in Phillipston, Fairhaven and Mattapoisett.

The commission has under its contract seventeen steam rollers and two portable stone-crushing plants. These were purchased primarily for the use of small towns which have made appropriations for building roads, but own no road machinery.

The steam rollers were used 945 1-2 days on town work in thirty-two different towns. All requests for service of this character were granted.

They were also used 394 days on state highway repair work, on thirty-two different roads, 244 days by towns contracting for building state roads, and 194 1-4 days by private contractors on state road contracts. The total number of days' work during the same year was 1,778, an average of 104 1-2 days for each roller.

The same general arrangement for care and maintenance has been followed as was described in the last report of the commission. The total cost of maintenance for the year was $2,051.39.

In all cases where a state roller was used by a state road contractor a certain charge per day has been made, and the cost for its use was deducted from any money due him under the contract. With the town as contractor a smaller price per ton has been allowed for rolling. No income appears on the books as coming from these sources, but the cost of the roads to the state is reduced by the amounts deducted. The amounts which should be credited to the state on account of roller rentals are as follows:

State roads, town contracts.....	$413.07
State roads, private contracts....	898.00
Total	$1,311.07

Deducting the receipts from the total cost of repairs leaves $740.32 as the cost of 394 days' rolling on state highway re-

pairs, or an average of $1.88 per day. Rollers could not be hired for this purpose for less than $5 per day.

The average cost of maintenance of the rollers was $1.15 per day.

In the opinion of the commission, the state rollers are an excellent investment. They stimulate good work on town roads, lower the cost of state road repairs, and prevent annoying delays on state road contracts.

One of the portable crushers has been located in the town of Sandisfield, where it has been of good service; the other was used in Carver and Hanson. The stone for 2.06 miles of stone roads was crushed by these machines—a total of about 5,500 tons.

Nothing was paid out by the state on the crushers, as they were operated and repaired by the towns using them.

Most of the culverts and short bridges built during the past year have been of reinforced concrete. With the added experience of another year, the men have become more expert.

The structures present a neater appearance, are fully as strong and cost less than those of masonry.

Reinforced concrete bridges were built as follows: One 18-foot span in Orange, one 15-foot span in Rehoboth, one 12 1-2 foot span and 6 1-2 foot span in Dartmouth. One reinforced concrete arch of 79-foot span was built in Williamstown. One steel girder bridge, with plank floor, of 40-foot span, was built in Buckland.

Bridges with steel I-beams and concrete arches were built as follows: One of 31.93-foot span in Buckland, one of 26-foot span over the Shawsheen river in Bedford, one of 10-foot span in Richmond.

Grade Crossings in Cleveland, Ohio.

The city council of Cleveland, Ohio, authorized, June 5, the Pennsylvania Railroad company to begin the elimination of its grade crossings. The road crosses all the important thoroughfares in the east end of the city, beginning at the lake and extending to the extreme southern end of the city, a distance of seven miles. The railroad company and the city will bear jointly the entire cost of the improvement, which will be more than $4,000,000.

Rochester Street Railway Must Pave Between Tracks.

A decision was rendered by the Court of Appeals, at Rochester, N. Y., June 9, holding that the Rochester Railway Company must pave between its tracks in streets where it held franchises prior to the passage of the general railway act, as well as subsequent thereto. A test case was made of the Park avenue case. The court was divided on the decision, the city having a majority of one.

Track Elevation at Indianapolis Begun.

The work of track elevation was begun in Indianapolis, June 13, at Thirteenth street and the Lake Erie & Western tracks. The Marion County Construction Company has the contract for the Massachusetts avenue track elevation, and the work begun at Thirteenth street is on the approaches preliminary to the elevation at Massachusetts avenue and Tenth street. This work will require 10,000 barrels of Portland cement and 8,000 yards of crushed stone.

Notice of Paving Ordinance Necessary.

The Supreme Court of New Jersey filed an opinion, June 12, setting aside the Atlantic avenue paving ordinance, at Atlantic City, and all proceedings under it. The setting aside of the ordinance is based on the failure of the city to give proper notice of City Council's intention to pass the paving ordinance and because no notice had been given of the assessment of benefits on the adjacent property. Certiorari proceedings were brought by the Barber Asphalt Paving Company and Charles E. Sears, of Atlantic City, against Atlantic City and the Cleveland Trinidad Paving Company, of Cleveland, Ohio, to test the validity of the ordinance, and also to review the action of City Council in giving the contract to the defendant company.

In the syllabus of his opinion, Judge Swayze says:

A municipal ordinance directing that a street be paved and the cost assessed upon the property benefited is a judicial act, and it is essential to its validity that notice be given and an opportunity for a hearing be afforded to property owners liable to be affected thereby, although the city charter does not expressly require such notice.

A notice of hearing before commissioners to assess benefits after the completion of the improvement does not suffice.

In the view I take of the case, it is not necessary to consider the objections made to the contract. I think the ordinance itself cannot be maintained, for the reason that it was passed without notice of any kind to the persons whose property will be affected. It was held by Chief Justice Green, in an early case, that an ordinance for paving a street was a judicial act and that notice was necessary,

and this view was approved in Vanatta, Morristown, 5 Vroom 445, and other cases.

I think that there can be no question that an ordinance for paving, which included a determination that the costs shall be assessed upon the property benefited, is judicial in its character. If so, notice is required upon general principles of justice, although not required by city charter.

It is, however, argued by counsel for the city that the notice required to be given by the commissioners of assessment is sufficient. But this notice only enables the land owner to be heard upon the question of the amount of the assessment. He is entitled to be heard upon the proceedings which are liable to result in an assessment. After the improvement is completed without objections on his part, it may be too late.

SEWERS AND SEWAGE

Columbus Sewage Testing Station—Septic Treatment of Sewage —Vitrified Brick for Sewers—Efficiency of New Haven Sewerage System.

The Columbus Sewage Testing Station.

By R. Winthrop Pratt, Engineer Ohio State Board of Trade.

The station is located about two miles south of the capitol, a short distance west of South High street, near the point where Moler street crosses the Hocking Valley railroad.

It was placed here in order to be near the main intercepting sewer, so that sewage, representative in character of the sewage from the entire city, could be easily obtained in sufficient quanties for testing purposes. To this end, an electrically-driven centrifugal pump has been placed in the big sewer, and, operating continuously, raises about 350,000 gallons per day of sewage into a screen chamber 5 feet by 2.5 feet by 3 feet, and provided with a double set of movable screens. From the screen chamber the sewage flows by gravity through the various tanks, filters and other devices designed to purify it. A preliminary screening also takes place in the intercepting sewer at the point where the sewage is drawn into the suction of the pump.

There are seven tanks, each 40 feet long, 8 feet wide, 8 feet deep at the upper end and 9 feet deep at the lower end, holding about 12,000 gallons. These tanks are used in various ways to effect a preliminary treatment of the sewage. They are of wood lined with galvanized iron; though in a permanent plant they would be of masonry.

The first two tanks are used as grit chambers, in which the sewage remains about one and a half hours. All the sewage at the station is at present passed through these tanks before it flows to the other tanks or to filters, though the piping is so arranged that the use of these tanks may be omitted if desired.

The third tank is used as a "plain sedimentation" tank, in which the sewage is retained about eight hours, in order that as much suspended matter as possible may settle out. With this tank it is not expected, as is the case with the septic tank, that little or no cleaning will be necessary. On the contrary, it is expected that the settled suspended matter at the bottom of the tank will be removed frequently, and no septic or sludge-destroying action encouraged, although a certain amount of such action does take place, as is shown by the bubbles arising from the bottom.

The fourth and fifth tanks are used to test the efficiency of precipitating out the suspended organic matter by means of chemicals; copperas and lime being used in one instance and alum in the other.

The sixth and seventh tanks are used as septic tanks, through which the sewage takes eight and sixteen hours respectively to pass and in which bacterial action, similar to fermentation, is encouraged in order to liquefy or gasify as much as possible of the organic matter, especially the suspended organic matter in the sewage.

The effluent flowing from any of these tanks has at best been only partially purified (that is, a portion of the solid matter has been removed) and the escaping

liquid is foul and putrescible. To study the best methods of rendering this liquid harmless thirty-five filters have been built.

These filters consist of cypress tanks six feet deep, and filled with the various filtering materials which it is possible to use in the final plant. Thirty of them are 7.5 feet in diameter, or .001 acres in area; four are 12 feet 10 3-4 inches in diameter, or .003 acres in area, and one is 10 feet in diameter. There are twenty-one intermittent sand filters; two preliminary contact-beds of broken stone; four secondary contact-beds of coke; two coke strainers; five sprinkling beds of broken stone, and one reserve filter.

The intermittent sand filters are being tested for their ability to purify at different rates of filtration, the effluents from each of the various tanks as well as the effluent from the contact-beds, coke strainers and sprinkling filters. The same liquid is usually applied simultaneously to two adjacent sand filters, but in different quantities, i. e., at different rates. When a filter having the higher rate refuses to purify its applied liquid and the filter having the lower rate works satisfactorily, the indication is that the former is receiving too much sewage in proportion to its area, and if large works were designed with this higher rate as a basis they would not be successful. Thus by varying the rates until the highest practicable one is determined, the proper data for the design of a large plant are obtained. These intermittent sand filters, as their name implies, are "dosed" (i. e., the sewage is applied to them) only during a portion of the time, perhaps a few hours each day, thus allowing the air to thoroughly penetrate them between applications and nourish the bacteria which dwell in the sand and purify the sewage.

With contact-beds, which are always of coarse material, i. e., broken stone, coke, slag, coal, cinders, etc., the sewage is held in contact with the material for a certain length of time, by closing the outlet, until it is purified or partially purified, as in sand filtration, by the bacteria which live in the filter.

Sprinkling filters are always of coarse material; the sewage being applied continuously in thin streams and passing through the filters constantly. It has been shown, especially in England, that this type of filter is very economical if it can be successfully operated, as larger quantities of sewage can be treated on a given area than with other methods. The chief objections are that it is difficult to apply the sewage properly, and that there is great danger of freezing in winter.

The effluent from both sprinkling filters and contact-beds sometimes contains harmless suspended matter, which can be removed by sedimentation. Tanks for this purpose have been provided at the station.

The piping is so arranged that nearly any combination of tanks and filters may be used, in order to determine which will give the best results.

The following are examples of the methods of treating the sewage at the station:

Intermittent Sand Filters 1 and 2.

Plain Settling Tank A, thence to Intermittent Sand Filters 3, 4 and 5.

Chemical Precipitation Tank A, thence to Intermittent Sand Filters 6 and 7.

Chemical Precipitation Tank B, thence to Intermittent Sand Filters 6 and 7.

Septic Tank A, thence to Intermittent Sand Filters 10 and 11.

Septic Tank B, thence to Intermittent Sand Filters 12 and 13.

Contact-Bed B, thence to Secondary Contact-Beds A and B.

Sprinkling Filter A, thence to Settling Basin C, thence to Intermittent Sand Filters 16, 17 and 18.

Sprinkling Filter B.

Plain Settling Tank A, thence to Sprinkling Filters C and D.

Coke Strainer A, thence to Intermittent Sand Filters 14 and 15.

Coke Strainer A, thence to Contact-Beds C and D.

Coke Strainer B.

The laboratory is a one-story frame building 64 feet by 31 feet, and contains the main office, an office for the inspectors, a chemical laboratory, bacterial laboratory, preparation room, store room, work shop and toilet. A large ice chest opening into the preparation room as well as into the bacteriological laboratory, has been found very convenient in handling samples which must be kept on ice. Both laboratories are well equipped with modern apparatus, and are arranged to facilitate the accomplishment of a large amount of work.

The station is operated day and night, seven days in the week, the various filters being tested nearly every hour. This necessitates continuous supervision, and obliges every member of the staff to give practically his entire time to the work. The duties of the men are so systematized, however, that it is possible for one man to take an occasional day to himself and leave his duties to be divided among his co-workers.

In addition to the sewage work, extensive tests are now being carried on in regard to softening of the Columbus water supply; this being preliminary to the design of the water filtration and softening plant which the city of Columbus is about to build.

Septic Treatment of Sewage in the United States.*

By GEORGE W. FULLER, New York.

This is a modification along biological lines of plain sedimentation, and consists in general in allowing the accumulated deposits to remain within the settling tank, where bacterial action under favorable conditions causes putrefaction and thereby the liquefaction, and ultimately the gasification, of a substantial proportion of the suspended organic matter.

In a rough way it may be said that of the matter suspended in ordinary municipal sewage, about one-third passes through the septic tank and appears in the effluent; about one-third is liquefied and gasified; and the remaining third, consisting chiefly of suspended mineral matter, remains with the tank and ultimately requires to be removed and disposed of as sludge. The efficiency of the septic treatment depends to a very large degree upon local conditions, especially the composition of the sewage, and each of the three ways above noted as to the disposition of suspended matter may show a range of from 15 to 50 per cent. of the total instead of the general average of 33 1-3 per cent. as stated above.

The efficiency of this treatment consists of more than the removal of sludge or suspended matter from sewage going to the filters, as it brings about a partial mixing of the sewage of widely varying strength as it flows at different hours of the day, and ordinarily it causes the organic matter to be broken down into simpler forms, which are believed to be more readily treated by filtration.

A few years ago the idea existed in the minds of some that the septic treatment was a complete process of purification by itself. Obviously this is not correct, as it removes, generally speaking, less organic matter (ordinarily about 40 per cent.) than does the chemical precipitation method, although there are some exceptions to this latter statement.

The effluent from a septic tank never contains dissolved oxygen after the process is normally established, and it goes without saying that the effluent is not stable; that is, it putrefies (or, better said, continues to putrefy) when allowed to stand unmixed with water.

The most practicable field for the septic treatment seems to be in connection with the treatment of strictly domestic sewage in which suspended mineral matter is present in only a very small amount. In sewages where the suspended mineral matter is an important factor, it is highly desirable to eliminate from the sewage, preparatory to septic treatment, the coarser mineral sludge by means of plain sedimentation tanks, from which the sludge is removed from time to time before putrefaction sets in.

Regarding the period of treatment best adapted for the septic process, or, more accurately stated, the size of tank or basin to be used, the evidence is not conclusive, as the individuality of local conditions exerts a marked influence. In a general way the tanks should have a capacity equal to twelve to twenty-four hours' flow at the average rate.

The idea is sometimes advanced erroneously that the septic treatment of sewage is confined to the period occupied by the flow of the sewage through the tank. This is not so, as the controlling features are that the rate of flow, or velocity, must be such that there is deposited on the bottom of the tank a substantial proportion of the matters in suspension. In this accumulated sediment upon the bottom of the tank bacterial action becomes established, which gradually converts the suspended organic matter into dissolved matter, and the latter in turn is converted to gaseous constituents.

The over treatment of sewage by the septic process is a factor encountered at the small plant at Andover, Mass., and resulted in an effluent which with difficulty could be filtered and nitrified. This complication developed when the sewerage system was only in partial use and the sewage was abnormally old and "stale," as it reached the disposal field. It could apparently be remedied by aeration of the septic effluent prior to its filtration. Presumably this feature will disappear in a large measure when more connections are made to the sewers already built, and the sewage is fresher as it reaches the field.

The odors in the neighborhood of septic tanks are usually noticeable at some little distance, although ordinarily they are not seriously objectionable even at the tanks themselves. With some kinds of sewage, however, this is not the case. In general, bad odors result from the septic treatment of those sewages containing relatively high amounts of sulphur compounds, such as the acid sewage of Worcester. A similar result is possible in a less degree with the sewage from communities in which the water is hard, due to sulphates of lime and magnesia. Where sulphate contents are fairly low these odors, perhaps somewhat allied to sulphuretted hydrogen, are generally not so conspicuous.

Covers for septic tanks do not seem to

*From a paper before the Engineering Congress at St. Louis.

facilitate to a marked extent the septic process, as the accumulated scum or crust generally present on the surface of the liquid serves that purpose in a measure. It does not wholly serve it, however, as severe wind storms are apt to bring about disturbances, scattering the scum and resulting in bad odors. The question of covers, to the thought of the author, is still unsettled, and depends largely upon local conditions.

The influence of temperature upon the septic process is marked, and in a rough way follows the influence of temperature upon nitrification as has been outlined in connection with intermittent filters. The relation between temperature and septic action has been shown by Messrs. Kinnicutt and Eddy by the determinations by months of the relative volumes of evolved gas from a closed septic tank at Worcester, Mass., during 1902, as given in the accompanying table.

This escaping gas on an average is composed of about 75 per cent. marsh-gas, 15 to 20 per cent. nitrogen, and the remainder mostly carbonic acid and nitrogen. Gas from the highly septicised sewage at Andover, however, contained 29 per cent. marsh-gas and 61 per cent. nitrogen.

The period of time required for septic action to become established in new or clean tanks ranges generally from about two weeks to two months, depending upon the temperature and composition of the sewage. Acids and trade wastes have in general a retarding influence upon this bacterial process.

As the effluent leaves the septic tank it contains much gas in dissolved form, which requires considerable air for its oxidation. This is well shown in the Lawrence report of 1900, p. 387, where is described the rapid absorption of oxygen by a septic effluent, both without and with sterilization by chemicals, but where the absorption by the same effluent was nil after expelling the gases by heat. Aeration of the effluent of the septic tank facilitates filtration and makes higher rates feasible, but, on the other hand, it has its drawbacks on the ground of producing under some conditions seriously objectionable odors.

The amount of suspended matter in the effluent varies considerably, due to a variety of factors, among which may be mentioned the character of suspended matter in the raw sewage, temperature, amount of sediment in the tank, and evolution of gas which at intervals belches forth and carries with it much sludge. The suspended matter is sufficient in amount sometimes to make it worth while to consider their removal by further preparatory treatment prior to filtration, that is, by settling basin or roughing filters. The suspended matter is ordinarily quite finely divided, however, so that its removal is not easy.

This process by no means eliminates the sludge question, and, generally speaking, septic tanks treating sewage require cleaning several times a year, although there are exceptions, particularly where house sewage alone is treated. A rough idea of the sludge accumulations in septic tanks may be obtained by dividing by three the quantities of total suspended matters in different sewages. At Plainfield, N. J., the city engineer, Mr. Gavett, reports that during a five-month period between cleanings, the wet sludge removed from the septic tank at that city was about 4.5 cubic yards per 1,000,000 gallons. The sludge from septic tanks is difficult to dispose of on a very large scale, unless carried to sea in vessels, as it cannot always be pressed advantageously into cakes, as in the case of sludge from chemical precipitation works. For small or moderate sized plants it can be applied to land and composted.

RELATIVE VOLUMES OF GAS EVOLVED BY CLOSED SEPTIC TANK AT WORCESTER, MASS., 1902

Month	Mean Temp. in Degrees, Fahr		Volume of Gas	
	Sewage	Effluent	Per cent. of sewage flow	Per cent. of yearly mean
January	48.16	46.58	1.171	30
February	47.01	45.74	2.448	62
March	46.68	45.86	1.866	48
April	49.15	49.10	1.9 6	51
May	55.43	55.77	3.979	100
June	59.54	61.52	5.837	148
July	64.22	63.68	5.521	140
August	66.38	65.84	6.624	167
September	66.56	64.76	6.689	170
October	61.16	60.08	4.550	116
November	57.02	55.76	4.528	115
December	49.28	48.56	2.572	65
Mean	55.88	55.27	3.939	100

For many years special strainers of excelsior, straw and various other materials have been used in efforts to remove from sewage more or less of the solid matters. Benefit has been derived, no doubt, from some of these arrangements at manufacturing establishments, but for municipal sewage these earlier efforts at straining, as practiced some years ago at Atlantic City, N. J., and Long Branch, N. J., have been abandoned as impracticable. Unless the expense becomes relatively great, it is understood that their efficiency is very small.

The use of roughing filters or strainers of fairly fine material has been studied

at Lawrence for about ten years. Coal and coke have been the materials most used in these studies, and it would seem that this method of preliminary treatment or clarification of sewage may have more merit than American engineers have generally been inclined to give it credit for. This is especially true where purification works have been located near a pumping station, and where the accumulated sediment or sludge at or near the surface of the strainers can, after air drying, be used for fuel purposes under boilers.

On a practical scale such strainers were put in use at Gardner, Mass., in 1901, where there are four strainers, each one-eighth acre in area. The material is 15 inches thick, composed of 6 inches of crushed stone and 9 inches of coke breeze. About 300,000 gallons of domestic sewage have been applied daily, with the result that about 70 per cent. of the total organic matter is removed in this way during the warmer season of the year. The surface requires cleaning about once in ten days, the material removed equaling about two cubic yards per 1,000,000 gallons. Frost prevents the filters being cleaned at such frequent intervals, and during the past winter these strainers went out of service early in January. Although it is necessary in this climate to cover such strainers for winter service, it does not necessarily eliminate this treatment from practical consideration under some conditions.

In 1892 investigations were begun at Lawrence with the artificial aeration of coarse gravel filters, to which sewage at relatively high rates was applied, with the view to partly purifying it so that final purification could take place at a relatively high rate in an ordinary sand filter. These filters were continued in service for five years, and similar ones were tried, containing cinders, coke and other materials. Air was artificially drawn through the filtering material, in some cases in an upward direction and in others in a downward direction, but in all cases these filters clogged in a manner which indicated decisively that this artificial aeration, while beneficial to a certain degree, was not helpful in proportion to its cost unless power was available at nominal expense.

Colonel Waring tested at some length a similar device at Newport during 1894, which device was installed on a practical scale in connection with other portions of the Waring system at Willow Grove (near Philadelphia), East Cleveland, O., and a number of small places elsewhere. So far as known, experiences on a practical scale lead to no conclusions other than that above stated in connection with the Lawrence investigations.

Contact Filters, or Rapid Filtration through Coarse Material on the Fill and Draw Plan.—This method of filtration came to attention in England some ten or twelve years ago, and has been used in this country sufficiently to demonstrate clearly that nitrification is possible at rates far in excess of those which can be used in ordinary intermittent sand filters. This method of treatment consists ordinarily of filling with sewage filters containing fairly coarse material, such as broken stone, coke, and the like, allowing the filter to stand for a short period after the pores are filled with sewage, then slowly draining it. By this procedure nitrification is brought about, and there is obtained an effluent which is fairly stable as to the residual organic matter which it contains. That is, this type of filter will, under favorable conditions, provide an effluent that does not putrefy, although it is greatly inferior to the effluent of intermittent sand filters as regards turbidity, organic matter and bacterial contents.

These filters can for a time be operated on the basis of three complete cycles, or fillings, per day, although provision should be made for allowing the filters to rest for several days at a time now and then. When moderately free from clogging material, the rate of filtration will approximate roughly the cubic contents of the filter beds, assuming that the voids approximate one-third the total contents. Within certain limits their capacity is roughly proportional to their depth.

In practice it is found that it is essential that these filter beds be constructed with ample underdrains at the bottom, and that the material be of stable character, such as will not disintegrate. The percentage of voids in these beds ordinarily is in the vicinity of 50 per cent. when the material is new, but gradually they are reduced by compacting and by the filling of the voids by suspended matter until, in the course of time, the voids amount to 25 per cent., or even as small as 20 per cent., of the cubical contents.

The size of material best adapted to contact beds is believed to be about one-half inch average size, ranging from particles which will pass through a sieve with one-inch mesh and be retained on a sieve of one-quarter-inch mesh. Coke and broken stone, with their rough surfaces, seem to be somewhat superior to gravel.

The loss of capacity of the voids is one of the most important features in connec-

tion with this type of filtration. By resting the filters it is possible to have them dry out, so that the accumulated sludge or organic matter will in part oxidize and nitrify, and in part crack, peel and pass from the filters with the effluent. Complete removal of clogging material is hardly feasible in this way. Further aid may be obtained by flushing the material in place.

This style of filter usually produces a quite turbid effluent, due in part to the matters detached from the filtering material and in part to the passage of suspended matter with the sewage through the filtering material.

Generally speaking, the suspended organic matter in the effluent is of a fairly stable character—that is, it will not putrefy on standing. It is perfectly feasible to remove a considerable portion of this suspended matter in the effluents of contact beds by means of straining at a rapid rate through a filter, or by sedimentation.

In a number of places double contact beds are provided, whereby the effluent, after single treatment, is passed through a similar filter at a lower level and at a higher rate. At some places this is advantageous, but it seems doubtful whether it is a preferable method, under many conditions, to the use of a single contact bed, operated at a lower average rate, using the same total area as with double filtration.

There seems to be no good reason why contact beds should be condemned on account of the fact that they clog up at times and require the materials to be taken out, and either put back after cleaning or replaced with new material. It is certain that this type of filter is not a permanent one for any rate approaching those which have been used in this country. The most economical rate varies largely, no doubt, with local conditions, particularly the cost of constructing the beds. It is largely a question of balancing the increased cost of operation due to high rates with the increased capital charges due to constructing increased filter areas, which permit of low rates.

Comparatively little information in precise terms is available in this country as to the cost or frequency of removing clogging, or as to the efficiency of contact beds on a large scale. In most cases these filters have been operated with quite dilute sewage, from which a portion of the sludge has been removed by the septic treatment or other means. It is to be stated, however, that at Plainfield, N. J., and other places, contact beds have been operated at rates approximating 500,000 gallons per acre daily for two or three years or more, with merely nominal cost for cleaning.

Intermittent Continuous Filters, or Sprinkling Filters.—These filters resemble contact beds somewhat, although the material is usually of larger size, one inch to three inches. Instead of filling the pores of the material with sewage and allowing it to drain out, it is sprayed in the form of rain over the surface, either by moving sprinklers or by spraying from nozzles set in stationary piping. The severe winter weather in the northern portion of this country interferes seriously with these distributing devices. While this method has much merit for Southern towns and cities, its applicability is somewhat uncertain at present in the North on account of this question of distributing devices, although experiences at Madison, Wis., and elsewhere, indicate that successful results may follow the application of sewage to coarse-grained filters in small but frequent doses, through lines of perforated tile pipe laid quite close together, and covered to protect them from cold weather.

The rate of filtration by this method is somewhat greater than that which can be maintained in contact beds with an equal quality of effluent as to putrescibility. This is due to the fact that the applied liquid is better aerated, which is also true of the voids in the filtering material, which seem to free themselves to a further degree of the accumulated sludge than in the case of the contact beds. The effluent of this type of filter is generally less turbid than that of contact beds, and the suspended matters, according to the Lawrence experiences as reported by Mr. Clark, are of a more stable character and can be removed more readily by settling than in the case of those from contact beds. Bacterially, these filters give better average results than contact beds, although in this respect all coarse-grained rapid filters are much inferior to the ordinary intermittent sand filter.

In the South this method is probably somewhat cheaper as well as more efficient than contact beds, but in the North this question is apparently an open one until more study is given to designs for applying sewage satisfactorily during freezing weather. While these devices are more expensive than those required for contact beds, it is not to be forgotten that with this method it is not imperative to place the filter beds in water-tight basins—that is, retaining walls may be omitted.

Automatic Devices for the Application of Sewage.—For the systematic application of sewage to filters, espe-

cially contact beds, there are several devices on the market, most of which, it is believed, work pretty well so long as the filters are in good condition. So far as known, there are no devices for treating filters which are clogged seriously, and probably there will not be. In other words, sewage filtration, while much benefited by "dosing devices," must also receive competent attendance and supervision if good results are to be regularly secured. Much progress in the last ten years has been made in means for applying sewage to filters, but there is still much room for improvement, especially as regards "continuous intermittent filters."

Even in the case of intermittent sand filters it is worth noting that there are nearly as many designs for sewage application as there are plants. Most of them work well enough in warm weather, but during freezing weather this is hardly so, except, perhaps, in the case of very small beds.

Concerning Patents.—Ten years ago the engineer, in designing a sewage purification plant, had little or no occasion to consider the patent question. As available methods have been supplemented since that time by coarse-grained rapid filters and by various preparatory treatments, including the septic process, numerous patents have been issued in this country. Generally speaking, engineers have been disposed for the most part to disregard these patents until the validity of their claims was established by court decisions, especially as the patents were claimed by their owners to cover pretty nearly all designs except those for simple intermittent filtration or simple chemical precipitation. It is said that practically all "compound" types of treatment, involving more than one step, are claimed to be covered by patents.

What the merits or demerits may be of these various claims cannot be touched upon in this review, in advance of court decisions, other than to record the fact that the city of Plainfield, N. J. (which built septic tanks and contact beds in 1901), is defending a suit brought by the United States Sewage Purification Company for alleged infringement of their patent No. 559522, and settled another suit brought by the Cameron Septic Tank Company for alleged infringement of their patent No. 634423. The city of Pawtucket, R. I., which at times has operated their settling basin as a septic tank preliminary to intermittent filtration (works built in 1893), successfully defended a similar suit brought by the former company.

Vitrified Brick for Sewers.

By GEO. S. WEBSTER, Philadelphia, Pa.

In a discussion of sewer construction before the Philadelphia Engineers' Club Mr. Geo. S. Webster presented the following:

In some of the old sewers which have caused trouble in the city of Philadelphia it has been found upon investigation that the brick inverts were partly or wholly worn out; this was especially true where the velocities were great and where gravel or other heavy material had entered the sewer. To avoid this, in modern construction the inverts of brick sewers having high velocities are built with granite or trap rock blocks. Where the velocity of the sewer when running full will be less than 12 feet per second, and more than 8 feet per second, vitrified shale bricks are used, and for velocities lower than 8 feet per second the inverts are formed of hard-burned clay bricks.

In designing sewers the following table has been adopted, giving the gradients for the determination of the materials to be used in sewer inverts.

At a number of places in the old Cohocksink sewer, which is 13 feet in diameter, the bottom was found to have been completely carried away. The ordinary flow amounts to about two feet in depth. In making examinations, inspectors, walking through the sewer with a safety line, would at points suddenly drop into holes two or three feet deep, showing that the whole foundation had washed out, leaving the arch with but little support.

All large sewers built in recent years have been founded in masonry or concrete cradles.

TABLES OF GRADIENTS FOR THE DETERMINATION OF THE MATERIALS TO BE USED IN SEWER INVERTS.

TABLES FOR CIRCULAR SEWERS.

Vitrified Shale Brick Invert to Springing Line to Be Used in All Cases Where Gradients Are More Than—

Diameter.	Grade per 100 Feet.
3 feet 0 inches	1.000 feet
3 feet 6 inches	0.788 feet
4 feet 0 inches	0.652 feet
4 feet 6 inches	0.553 feet
5 feet 0 inches	0.478 feet
5 feet 6 inches	0.420 feet
6 feet 0 inches	0.373 feet
6 feet 6 inches	0.335 feet
7 feet 0 inches	0.303 feet
7 feet 6 inches	0.277 feet
8 feet 0 inches	0.254 feet
8 feet 6 inches	0.234 feet
9 feet 0 inches	0.217 feet
9 feet 6 inches	0.203 feet
10 feet 0 inches	0.190 feet
10 feet 6 inches	0.178 feet
11 feet 0 inches	0.168 feet
11 feet 6 inches	0.158 feet
12 feet 0 inches	0.150 feet
12 feet 6 inches	0.142 feet

Gradients for Vitrified Shale Brick Inverts—Continued.

13 feet 0 inches	0.135 feet
13 feet 6 inches	0.129 feet
14 feet 0 inches	0.123 feet
14 feet 6 inches	0.118 feet
15 feet 0 inches	0.113 feet
15 feet 6 inches	0.108 feet
16 feet 0 inches	0.104 feet
17 feet 0 inches	0.097 feet

NOTE.—These gradients are figured for a mean velocity of 8 feet per second, running full or half full. When running 0.3 full, velocity equals 6.24 feet per second.

Stone Block Invert to Springing Line to Be Used in All Cases Where Gradients Are More Than—

Diameter.	Grade per 100 Feet.
3 feet 0 inches	2.207 feet
3 feet 6 inches	1.782 feet
4 feet 0 inches	1.466 feet
4 feet 6 inches	1.244 feet
5 feet 0 inches	1.076 feet
5 feet 6 inches	0.944 feet
6 feet 0 inches	0.839 feet
6 feet 6 inches	0.753 feet
7 feet 0 inches	0.682 feet
7 feet 6 inches	0.623 feet
8 feet 0 inches	0.572 feet
8 feet 6 inches	0.527 feet
9 feet 0 inches	0.489 feet
9 feet 6 inches	0.456 feet
10 feet 0 inches	0.427 feet
10 feet 6 inches	0.401 feet
11 feet 0 inches	0.378 feet
11 feet 6 inches	0.356 feet
12 feet 0 inches	0.338 feet
12 feet 6 inches	0.320 feet
13 feet 0 inches	0.305 feet
13 feet 6 inches	0.291 feet
14 feet 0 inches	0.278 feet
14 feet 6 inches	0.265 feet
15 feet 0 inches	0.254 feet
15 feet 6 inches	0.244 feet
16 feet 0 inches	0.235 feet
17 feet 0 inches	0.218 feet

NOTE.—These gradients are figured for a mean velocity of 12 feet per second, running full or half full. When running 0.3 full, velocity equals 9.36 feet per second.

TABLES FOR EGG-SHAPED SEWERS.

Vitrified Shale Brick Invert (See Std. Details) to be Used in all Cases where Gradients are More than—

Diameters.	Grade Per 100 Feet.
2 feet 3 inches × 1 foot 6 inches.	2.40 feet.
2 feet 6 inches × 1 foot 8 inches.	2.00 feet.
3 feet 0 inches × 2 feet 0 inches.	1.75 feet.
3 feet 3 inches × 2 feet 2 inches.	1.40 feet.
3 feet 6 inches × 2 feet 4 inches.	1.25 feet.
4 feet 0 inches × 2 feet 8 inches.	1.00 feet.
4 feet 6 inches × 3 feet 0 inches.	0.85 feet.

NOTE.—These gradients are figured for a mean velocity of 8.32 feet per second running full or half full. When running 0.3 full, velocity equals 6.24 feet per second.

Stone Block Invert (See Std. Details) to be Used in all Cases where Gradients are More Than—

Diameters.	Grade Per 100 Feet.
2 feet 3 inches × 1 foot 6 inches.	5.40 feet.
2 feet 6 inches × 1 foot 8 inches.	4.50 feet.
3 feet 0 inches × 2 feet 0 inches.	4.00 feet.
3 feet 3 inches × 2 feet 2 inches.	3.00 feet.
3 feet 6 inches × 2 feet 4 inches.	2.75 feet.
4 feet 0 inches × 2 feet 8 inches.	2.30 feet.
4 feet 6 inches × 3 feet 0 inches.	2.00 feet.

NOTE.—These gradients are figured for a mean velocity of 12.48 feet per second running full or half full. When running 0.3 full, velocity equals 9.36 feet per second.

The Efficiency of the New Haven Sewerage System.*

By FREDERICK JACKSON, New Haven, Conn.

The measure of the efficiency of any work is the completeness with which it performs the duties which devolve upon it.

The determination of this efficiency is accomplished by the periodic collection and compilation of statistics of the operation of the work under observation and the analysis of this data with relation to perfect results.

In the case of the New Haven sewerage system, the observations not having been sufficiently extended, we can not hope, from the data at hand, to reach a satisfactory solution of the problem, but rather to point the way for a more careful investigation.

In endeavoring to determine the efficiency of this system, we will first try to get the duration of the storm which will give a maximum discharge at each of the main outlets.

A short sketch of the history of the system was given to show its development.

Taking first the Meadow street outlet, and starting from the corner of Whalley avenue and Orchard street, its furthermost confine, we find the theoretical time required to traverse its length through its different feeders to be one hour seven minutes seventeen seconds. Adding five minutes for the time that would elapse between the beginning of the storm and its first reaching the sewers, we have one hour twelve minutes seventeen seconds; say one hour twelve minutes. That is the time of duration of a storm before it would produce at the outlet a maximum discharge.

Proceeding in the same manner with the remaining outlets, we get the following results:

East street	1 hr. 21 min.
James street	0 hr. 41 min.
Poplar street	1 hr. 6 min.
Boulevard	2 hrs. 35 min.

The relation that the duration of a rain bears to its intensity has been investigated by different municipalities, commissions and individuals, with widely differing results, due in part to difference in locality, and in part to personal judgment in analyzing the data. For the purpose of this paper, it will suffice, in lack of local data, to use the result of the investigations of Prof. A. N. Talbot, of the University of Illinois, of 499 stations in New England Atlantic states extending over a period of from one to fifty years, and that of Mr. Emil Kuichling, of the local condi-

*From a paper before the Connecticut Association of Civil Engineers.

tions of Rochester and the two neighboring stations.

Prof. Talbot developed two relations, one for rains of rare occurrence, the other for ordinary rains.

From these we determine the following:

	Duration.	Max Rate, inches per hour Talbot. Rare.	Talbot. Ordinary.	Kuichling.
Meadow Street	1 hr. 12 min.	3.4	1.2	.85
East "	1 hr. 21 min.	3.2	1.1	.82
James "	0 hr. 41 min.	5.2	2.1	1.56
Poplar "	1 hr. 6 min.	3.7	1.3	.86
Boulevard	2 hrs. 35 min.	1.8	0.7	0.7

Mr. Kuichling and Mr. Talbot practically agree in ordinary rains of long duration, but differ more widely the shorter the duration.

The entire amount of rain which reaches the sewers will depend almost entirely on the percentage of impervious area in the district considered.

To arrive at an approximation of this we may use the density method.

Assuming that the percentage of impervious area varies directly with the density of population, we may establish a relation between the number of persons per acre and the percentage of fully impervious surface per acre. This relation will vary from 15 per cent. at 15 persons per acre to 80 or 90 per cent. at 75 persons per acre. In this way we get for Meadow street district 56 per cent., East street 39 per cent., Boulevard 33 per cent. and James and Poplar streets 30 per cent. This gives as the amount of rain to be provided for—

	Rare.	Ordinary.
Meadow street	1.90	.67
East street	1.25	.43
James street	1.56	.63
Poplar street	1.11	.39
Boulevard	.59	.23

Now if we knew how often any one of these different rates would occur in a year or period of years we could determine how frequently the efficiency of the sewers would be tested.

The weather bureau station has been established at New Haven since 1872. But up to the time of the installation of the automatic gauges, no continuous record of the duration or rate, which are all-important in sewerage work, was kept. Previous to 1872 Prof. Elias Loomis compiled an average for each month for thirty years, but makes no mention of duration or rate. The weather bureau has a comparatively accurate record of the excessive rains which have fallen, that is, rains two and one-half inches and over, and also mentions some of those instances in which an inch or over fell in an hour or less.

Three storms are described as being fair types for this locality. The two classes of excessive rains most interesting to the sewerage engineer are those of great intensity and short duration, and those of light intensity and long duration. That of August 10-11 may be taken as illustrative of the second class, though the total precipitation does not quite equal the requirement for excessive rains. It began at 6 a. m. of the tenth, and continued uniformly until 10:30 a. m. The intensity then increased, and it continued briskly until 12:30 p. m. It then slackened, and ceased at 1:10 p. m. From then until 4:20 p. m. it was cloudy. At 4:20 p. m. it rained gently and continuously until 7:20 p. m., when it ceased. Beginning again at 10:40 p. m., rained briskly, finally ceasing at 3:10 a. m. Duration twenty-one hours ten minutes. Total precipitation, 2.02 inches.

That of August 19-20 was typical of the first class. It was cloudy with a trace from 6 p. m. until 12:30 a. m., then the rain began and continued at a gradually increasing rate until 7:40 a. m., when the rate became excessive until 9:50 a. m., 2.07 inches falling, as follows:

5 minutes	.05 inches
10 minutes	.08 inches
15 minutes	.13 inches
20 minutes	.22 inches
25 minutes	.31 inches
30 minutes	.54 inches
35 minutes	.67 inches
40 minutes	.76 inches
45 minutes	.87 inches
50 minutes	.95 inches
60 minutes	1.16 inches
80 minutes	1.47 inches
100 minutes	1.67 inches
120 minutes	1.94 inches
125 minutes	2.01 inches
130 minutes	2.07 inches

It then gradually decreased, and ceased at 12:35 p. m. Total precipitation, 2.99 inches. Duration eighteen hours thirty-five minutes.

The storm of September 14-15 was a very heavy one with two excessive rates, and rain continuous between them. Light rain and mist began at 8:15 a. m., ended at 9:25 a. m.; amount, .03 inches. Beginning again at 11:20 a. m., mist and rain continued at intervals, became heavy at 2:35 p. m., and ended at 2:50 p. m.; amount, .42 inches. Dense fog from 1 p. m. until 2:50 p. m., gradually disappearing. Rain began again at 9:10 p. m., continued until midnight, was excessive from 10:27 to 10:57; .58 inches falling, as follows:

5	minutes	.20 inches
10	minutes	.37 inches
15	minutes	.43 inches
20	minutes	.46 inches
25	minutes	.50 inches
30	minutes	.58 inches

Rain continued, ending at 7:50 a. m. on the fifteenth. Was excessive 4:16 to 5:56 a. m., 1.99 inches falling, as follows:

5	minutes	.06 inches
10	minutes	.19 inches
15	minutes	.32 inches
20	minutes	.44 inches
25	minutes	.60 inches
30	minutes	.71 inches
35	minutes	.83 inches
40	minutes	.96 inches
45	minutes	1.05 inches
50	minutes	1.18 inches
60	minutes	1.30 inches
80	minutes	1.56 inches
100	minutes	1.99 inches

Duration of storm, eight hours fifty minutes. Total precipitation, 3.96 inches.

An examination of these results shows very convincingly that the unit is not the hour, but rather the five or ten-minute interval in the study of storms for sewerage purposes.

As stated above, our data does not tell how often we may expect storms with a rate sufficient to cause a maximum discharge at the different outlets. But from the data of the weather bureau we may expect on an average about three in a year whose rate will be excessive. We do know, however, that the storms of August 19-20 and September 14-15 were the cause of numerous complaints. We know their rates and durations, and it will be interesting to compare them with the theoretical rates before determined. The duration for maximum for Meadow street is one hour twelve minutes and rate 1.2 inches per hour. On August 19-20 there fell in one hour, 1.16 inches. On September 14-15 there fell in one hour, 1.30 inches. For East street the duration is one hour twenty-one minutes, rate 1.1 inches. On August 19-20 there fell in one hour twenty-one minutes, 1.47 inches. On September 14-15 there fell in one hour twenty-one minutes, 1.56. For the Boulevard the duration is thirty-five minutes, rate .7 inch. On August 19-20 there fell in two hours ten minutes 2.07 inches. On September 14-15 there fell in one hour forty minutes, 1.99 inches. For James street the duration is forty-one minutes, rate 2.10 inches. On August 19-20 there fell in forty-one minutes, .76 inch. On September 14-15 there fell in forty-one minutes, .96 inch. For Poplar street the duration is one hour six minutes, rate 1.3 inches. On August 19-20 there fell in one hour six minutes, 1.26 inches. On September 14-15 there fell in one hour six minutes, 1.38 inches. Except in those storms of very long or very short duration the actual agrees fairly well with the theoretical, and, as will be noticed, the rates taken are for ordinary rains.

Now, in addition to the percentage of rainfall varying with the impervious area, the sewers must take a certain percentage of ground water through leakage; and a further addition of sewage proper, depending upon the water consumption per capita. They must also overcome at New Haven the conditions resulting from tidal setback in the low-lying districts.

Assuming that the daily water consumption is 140 gallons per capita, and that 75 per cent. of this is sewage flow, we add 100 per cent. for the maximum daily flow which must be taken care of by the sewers. This does not include the flow from large manufacturing concerns, which affects the daily variation. This gives us for the different outlets the following:

Meadow st.	.017 cu. ft. per acre per sec.
East st.	.012 cu. ft. per acre per sec.
James st.	.009 cu. ft. per acre per sec.
Poplar st.	.009 cu. ft. per acre per sec.
Boulevard	.01 cu. ft. per acre per sec.

The infiltration of ground water has been variously estimated from 4,000 to 6,000 gallons for a 6-inch pipe per mile per day. That for brick sewers would be considerably greater.

As to the effect of tidal setback, we have no data to guide us.

Disregarding the two, and remembering that an inch of rain per hour is equivalent to a cubic foot per acre per second, we get for the maximum amount finally to be taken care of:

Meadow st.	.687 cu. ft. per acre per sec.
East st.	.442 cu. ft. per acre per sec.
James st.	.639 cu. ft. per acre per sec.
Poplar st.	.399 cu. ft. per acre per sec.
Boulevard	.242 cu. ft. per acre per sec.

In endeavoring to determine the efficiency with which these outlets are doing their work we have calculated the area drained by each (this of itself must be an approximation), and from their diameters and grades their discharge in cubic feet per second, according to the formula of Kutter, using n equals .015. Dividing the second by the first we obtain the run-off in cubic feet per acre per second, which each outlet will take. These were plotted with the acres taken as abscissas and the run-off as ordinates. The several subdivisions are plotted on the plate in a similar manner. We have also, for the sake of comparison, plotted the curves corresponding to the run-off formulas given on the following page.

The Meadow street outlet serves an area of 668 acres, mostly well built up. It lies on the diagram between the

Hawksley-Bazalgette

$$q=C\sqrt[4]{\frac{8r^3}{A}} \quad \text{for } r=, \quad 1\ cr=3.95.$$

Adams

$$q=C\sqrt[12]{\frac{8r^{10}}{A^2}} \quad \text{for } r=, \quad 1\ cr=1.03.$$

Burkli-Ziegler

$$q=C\sqrt[4]{\frac{r^4S}{A}}$$

for $r=2.75$, $cr=11.61$ built up areas.
for $r=2.75$, $cr=9.59$ average city areas.
for $r=2.75$, $cr=4.79$ suburban areas.

$$S=s\times 1000$$

McMath

$$q=c'r\sqrt[3]{\frac{S}{A}} \quad \text{for } r=2.75 \ cr=, \ 8.21 \text{ built up areas.}$$

$cr=3.39$ suburban areas.

$$S=s\times 1000,\ c=\frac{c'}{1000}.$$

New York

$$q=crA.<{}^{15}S^{27}$$

$cr=10.59$ completely built up areas.
8.97 well built up areas.
6.59 suburban areas.

Hawksley-Bazalgette and Burkli-Ziegler curve for suburban areas. Its theoretical maximum would be reached at 0.687 cubic feet per acre per second, which would make it lie slightly above the New York curve for completely built up areas.

The East street outlet serves an area of 1,469 acres and lies below the Hawksley-Bazalgette curve. Its theoretical maximum would be reached at 0.442 cubic feet per acre per second, which would make it lie just below the New York curve for well built up areas. It is relieved, however, by the overflows at Greene street, Grand avenue, Humphrey street, Canern street and Rock Lane, which added would cause it lie about on the Burkli-Ziegler curve for built up areas.

The James street also lies below the Hawksley-Bazalgette; it serves an area of 275 acres. Its theoretical maximum would occur at 0.639 cubic feet per acre per second, which would make it lie between New York curve for well built up areas and McMath for built up areas. Relief is afforded it by the overflows at Grand avenue and State street. These added would cause it to lie about on the New York curve for suburban areas.

The Poplar street serves an area of 424 acres and lie on the Hawksley-Bazalgette curve. Theoretically its maximum would occur with 0.399 cubic feet per acre per second, which brings it between the Burkli-Ziegler curve for average city areas and the New York curve for suburban areas. It is relieved by the overflows at Grand avenue and Lombard streets. The addition of these would make it lie between the Burkli-Ziegler curve for built up areas and the New York curve for well built up areas.

The Boulevard likewise lies below the Hawksley-Bazalgette curve. It serves an area of 1,440 acres. Its theoretical maximum would occur at 0.242 cubic feet per acre per second, which would cause it to lie between the McMath curve for suburban areas and the Burkli-Ziegler curve for average city areas. It is relieved by overflows at Congress and Derby avenues, which added would cause it to lie between the New York curves for suburban and well built up areas.

We see, then, that the Boulevard, East, James and Poplar streets outlets are performing their work in a fairly efficient manner. There are, it is true, certain subdivisions of all four, from which occasional complaints are received. It would be interesting to take up these in detail and investigate them, but the limits of this paper will not permit. None of these districts as yet has reached the point where their proportion of impervious area preponderates. Their location is such, adjoining natural water ways, that when that comes relief can be easily afforded them. We may therefore say that their efficiency is good.

The remaining outlet, the Meadow street, with 56 per cent. of its area impervious, and increasing rapidly, in the future presents a condition which is not reassuring.

The duration of the storm which will cause a maximum discharge being com-

paratively short, its lower levels are running full relatively early in the storm. It contains most of the old sewers constructed prior to the design of the present system, which are inadequate to perform the work which they now have to do. Its location does not admit relief being easily afforded in its higher levels, and if relief outlets be constructed at its lower confines it is questionable if the results desired will be obtained.

To follow up its various subdivisions, to study them in their relations to the work which they have to perform, would so extend this paper, which already has exceeded its original limits, as to make it inexpedient at this time. We may conclude, however, that if our assumptions in the beginning of the paper are true, that its efficiency is very poor.

We may state further, that in the designing of sewerage systems, the Hawksley-Bazalgette and the Adams formulas have had their day. Both are based on a rate of an inch of rain an hour, and the occurrence of this rate at rare intervals. This we now know not to be so, but that it may occur as frequently as three or four times a year.

No formula may be applied indiscriminately, but each district should be carefully compared, in all its features, with some similar one, the results from which have been noted and studied, and a formula evolved and applied which will give the best results in the light of previous experience and practice.

Ordinance Governing Sewer Construction.

The following ordinance prepared by C. W. Swearingen, City Engineer of Havre, Mont., covers very completely the laying of sewer connections and can well be used as a model for other cities with only such modifications as local conditions require:

An Ordinance to Regulate the Construction, Alteration and Repair of Sewers and House Drains in the City of Havre, Montana.

Be it Ordained by the City Council of the City of Havre, Montana:

Section I—Supervision. The construction, repair and maintenance of all sewers, drains, and cess pools, whether public or private, shall be under the supervision and control of the city engineer.

Section II—License. No person, firm or corporation shall engage in or conduct the business of sewer connecting and house draining, or excavate any trenches for sewer pipe or open, uncover, or in any manner make connection with, or lay any sewer or drain, or attach to, modify or repair any appurtenances to sewer connections with the sewer in the streets or alleys or with any private sewer or drain in the city of Havre without holding the proper license for such work from the City Council of the city of Havre, Mont., excepting only persons operating under special contract with the city for such work.

Section III—Application for License. The application for license shall be presented to the City Council and endorsed by the city engineer; and no person, firm or corporation shall receive such license who does not have an established place of business within the corporate limits of the city of Havre, and who shall not first have furnished the city engineer satisfactory evidence of his or their responsibility and qualifications to ply their trade in accordance with the requirements of this ordinance and the engineer's rules for the conduct of such work.

Section IV—Bond. After favorable action by the City Council granting a license, and before the same shall be issued the applicant or applicants shall file with the city clerk a bond in the sum of fifteen hundred dollars ($1,500), which bond shall be approved by the mayor and the city attorney, conditioned upon the protection of the city of Havre against all loss or damage which may occur on account of such licensee through any carelessness or negligence in either the execution or protection of his work, or by reason of any unfaithful or inadequate work done by such person, firm or corporation, or by his or their employees, and that said licensee as such will also conform to the conditions and requirements of the city for his or their government, or in default thereof will submit to such penalties as are or may be prescribed by the city engineer.

Section V—License Fee. The license fee of a drain layer shall be forty dollars ($40.00) per annum, payable in advance, and no license shall be granted for a greater or less period than one year.

Section VI—Use of License. No person, firm or corporation engaged in the business of sewer connecting and drain laying shall allow his or their names to be used by any other person directly or indirectly, either to obtain a permit or to do any work under his or their license or bond.

Section VII—Permit. Before commencing the construction, modification or repair of any sewer, drain or cesspool the drain layer shall first obtain a written permit from the city engineer, and such permit shall be upon the ground at all times during the progress of work and must be shown any officer in authority on demand.

Section VIII—Application for Permit. All applications for permits must be made in writing upon the proper blanks for that purpose, and signed by the owner or his authorized agent, and when it is required they shall be accompanied by a plan showing the whole course of the drain which is to be constructed, together with the size of same, the location of all branches, depth of drain below the floor of building, and such other information as may be required by the engineer for the proper direction of the work. If the drain is to be connected with a sewer built by private parties, or to pass through property not owned by the applicant, the written consent of the owner must be procured and filed with the application before the permit is issued.

Section IX—Fee for Connection. A fee of five dollars ($5.00) will be charged and collected by the city engineer for each connection, to cover the cost of setting grade and filing in the engineer's office a plan of the work as completed. All moneys collected for sewer connections

shall be covered into the city treasury to the credit of the Sewer Maintenance Fund.

Section X—Barricades. Excavations in streets and alleys shall be made in such manner as to impede travel as little as possible, and the engineer may determine and limit the time such excavation may remain open, and when unnecessarily delayed he may direct that the number of workmen be increased to hasten the work to such an extent as he may deem necessary. Red lights shall be maintained upon all unfinished work at night, from dark to sunrise, and sufficient barricades shall be in place at all times until the work is completed.

Section XI—Refilling of Trenches. All trenches shall be refilled in a careful and workmanlike manner, and tamped or puddled so as to replace as nearly as possible all excavated material, and leave the surface in as good condition as before the commencement of work.

Special care shall be observed with trenches within streets and alleys, and all surplus material must be removed when work is completed, and any refilling of trenches necessary to maintain the highway in good condition for a period of one year shall be done by the drain layer.

Section XII—Size of Drains. No drain or sewer pipe shall be less than four (4) inches, internal diameter, and all sewers and drains shall be of sufficient size to accommodate the property they are intended to serve.

Section XIII—Pipe. All pipes shall be first quality, salt glazed, thoroughly vitrified earthenware, sound and well burned, smooth and thoroughly glazed exterior and interior surfaces. All connections shall be laid to a uniform grade. Changes in the direction of the sewer shall be made by bends and suitable fittings. Pipes shall not be cut or chipped except by permission of the inspector, and shall be done under his supervision. Each pipe shall be carefully bedded as laid, the joint filled with fresh mortar composed of one part Portland cement and two parts of clean, sharp sand. The pipe shall be covered with fine earth or sand, free from rocks, and throughly packed to prevent the slightest settlement of the drain. A swab shall be drawn through the pipe as laying progresses to clean the mortar joints and exclude objectionable material from entering the sewer. The swab shall be removed from the pipe by the drain layer at the completion of the work of sewer connection. Vitrified pipes shall not approach within two feet of any building, cellar, vault, or areaway, from which point cast iron pipes shall be used. In case soil pipe has been previously laid to said point by the plumber, the drain layer shall connect the two pipes in a careful and workmanlike manner.

Section XIV—Separate Connection. Every building shall be separately and independently connected with the sewer; provided, however, that when, in the opinion of the engineer, it is deemed advisable to connect two or more buildings or a line of tenements with the same sewer, the main drain or lateral shall terminate in a man-hole not less than two and one-half feet in diameter at the bottom and two feet at the top; the inverts shall be carefully formed in the concrete foundation and the top shall have a tight cast iron locking cover.

Section XV.—Cess Pools. Cess pools shall not be constructed on property abutting on sanitary sewers, and the use of old cess pools shall be discontinued when public sewers are constructed. Where cess pools are permitted they shall not be located within twenty-five feet of any dwelling, and shall not be less than six (6) feet square and twelve (12) feet deep, lined top and bottom and sides with two-inch plank placed close together, forming a tight chamber with a vent reaching six (6) feet above the surface.

Section XVI—Storm Water. Where rain water leaders are connected with the sewers provision must be made to secure against the entrance of any objectionable material into the sewer, and when connection is made on outside of building all rain water leaders shall be trapped.

Section XVII—Improper Use. Entrance into the manholes or opening the same for any purpose whatever except by the engineer or other persons duly authorized, is strictly prohibited. No one shall throw or deposit, or cause or permit to be thrown or deposited in any vessel or receptacle connected with the public sewer, garbage, hair, ashes, fruit, vegetables, peelings, refuse, rags, sticks, cinders, or any other matter or thing whatever, except human excrement, urine, the necessary closet paper, liquid slops, and drainage of such character.

Section XVIII—Inspection. The city engineer may adopt such rules as he may deem necessary to provide for proper inspection of the work, and no work shall be covered until it has been approved by the inspector, who will endorse a certificate of final inspection upon the permit issued for that particular work or connection.

Section XIX—Penalty. Any person, firm or corporation who shall be found guilty of violating any of the provisions of this ordinance, or who shall fail or neglect to comply with any of such provisions, shall, on conviction thereof, be fined not less than five dollars ($5.00) nor more than one hundred dollars ($100.00) for each offense, and ten dollars ($10.00) for each day such person shall continue in violation thereof.

Wilful violation of said regulations or of the directions of the city engineer or his inspector shall be cause for temporary suspension of the license of the offender by the city engineer pending final suspension by the city council. In addition to any other penalties that may be imposed under this ordinance, and such suspension shall operate until such penalties are paid and until license is restored by the City Council; nor shall such suspension give the offending party the right to the return of any money paid for such license.

Section XX. All ordinances and parts of ordinances in conflict with the provisions of this ordinance are hereby repealed.

Section XXI. This ordinance shall take effect and be in force from and after its passage, approval and publication.

Passed by the City Council this 5th day of June, 1905.

Approved by the Mayor this 5th day of June, 1905.

L. NEWMAN, Mayor.

Attest: R. E. HAMMOND,
Acting City Clerk.

CEMENT

Fine Grinding of Cement—Curing Cement Blocks.

The Kent Mill As a Fine Grinder.*

By George H. Fraser.

This subject of recent results obtained with the Kent mill as a fine grinder is particularly interesting now, for the reason that it is only recently that the Kent mill was considered seriously as a fine grinder. Having originally been regarded primarily as a coarse grinder or granulator, to be used for preparing feed for a tube mill, in which use it was found capable of feeding not only one tube mill, but several, and to have a capacity ranging from 30 to 50 barrels of clinker per hour with an expenditure of less than 25 h. p., and with a wear cost per barrel on this work approximately less than one-tenth of a cent per barrel at an expenditure of approximately ½ h. p., it is not surprising that we were content to regard the preliminary grinding field as essentially that to which the Kent mill belonged.

It is to the enterprise of the Portland cement manufacturers that we are indebted for much that we know about the Kent mill, and it was they who discovered its ability as a fine grinder. This came about as a result of their comprehensive tests, in the course of which their attention was attracted by the discovery that in the discharge from the Kent mill as a tube mill feeder, there was an exceptionally large percentage of very fine material. To illustrate this, one report which I recall indicated that while the mill was discharging some 40 to 60 barrels an hour of 20-mesh tube mill feed, the tests showed that this discharge averaged 49.5 per cent. of cement which would pass a 100-mesh test sieve, and about 33 to 35 per cent. which would pass a 200-mesh test sieve. The mill was feeding a number of tube mills, and it had been noticed that when the tube mills were fed by the Kent mill, the capacity of each tube mill was increased 20 to 30 per cent. Some difficulty in explaining this increase of tube mill capacity was at first experienced, but when the tests showed the remarkably high percentage of fines given by the Kent mill, the increase of tube mill capacity was easily explainable.

The cement manufacturer was not content to pour this large amount of already finished cement through a tube mill as a finisher. On the contrary, it is a wise expedient to avoid waste of horse power by separating out the finished cement before sending the rest of the discharge from the Kent mill to the tube mills. This brought up the question of separation. While separators had not heretofore been entirely satisfactory, the Portland cement manufacturers, now that there was material gain to be effected by separation, were not content to leave the problem of separation unsolved. They speedily improved both the inclined screen and the air separators, with the result that today separation is a comparatively simple, economical and convenient operation.

The two types of separators which are standard are, the inclined screen and the air separator. Each is really best suited to a distinctive field, although either may be used to some degree in the field of the other. The typical field of the inclined screen separator is on relatively coarse work from 100-mesh down, and that of the air separator is on very fine work from 100-mesh to 200-mesh and finer. When working on Portland cement, it is particularly advantageous to use a separator in its typical field, because of the peculiar wearing quality of the clinker. The inclined screen gives the best results for the coarser work, as for tube mill feed, and the air separator for the finer work, as for finished cement.

The inclined screen as perfected by the Newaygo Portland Cement Company is very satisfactory as a fine separator, and is especially advantageous as a preliminary separator, because on this work it is equipped with a coarse cloth of heavy steel wire of slight cost and great durability. Many of these separators are installed with Kent mills as tube mill feeders.

The recent perfection of the air separator was attained in adapting it to the cement industry. This was accomplished by Mr. George E. Emerick, of Philadelphia, long identified with the manufacture

*From a paper before the Association of American Portland Cement Manufacturers.

of Portland cement, who conceived the enclosed-air principle, and thereby escaped the disadvantages, expense, and cumbersome features incident to the old cyclone separator. By the enclosed-air principle, the separator is reduced to a single drum containing but one driven part, and requiring but little horse power. As the air is confined in this drum, there is no leakage or dust, and the compactness of the device is such that no floor space additional to that required for the grinder is required.

In one instance reports indicate a capacity from a Kent mill and an Emerick separator of 11.5 barrels per hour of finished Portland cement, testing 98.8 per cent. 100-mesh, 90 per cent. 200-mesh.

Another series of reports indicates a capacity of 10 barrels to 11.5 barrels per hour, testing 97 per cent. 100-mesh, 88.5 per cent. 200-mesh.

Naturally, the first inquiry on learning these results is, how the horse-power required for doing this work by the Kent mill as a finisher compares with that required for its previous work as a feeder. This point has been included in the careful tests of the manufacturers, and it will interest you to note that on this work the Kent mill does not exceed 25 h. p. The highest report I now recall of indicated horsepower when grinding finished cement at the rate of say 250 barrels per 24-hour day, is 23.8. This you will see is less than 2.4 h. p. per barrel of finished cement. It is evident, therefore, that the estimates of 25 h. p. as a maximum horse-power requirement for the Kent mill on any work, is safe, and that while the law that capacity diminishes as the fineness of grinding increases, applies to the Kent mill as to all other grinders, there is no proportionate increase of power required for the machine in one class of work more than in another, but there is, of course, an increase of power required per barrel ground as the fineness increases, as will be apparent when you recall that the power required per barrel for making tube mill feed in the Kent mill was less than 1-10 h. p. per barrel, whereas, when the Kent mill is doing all of the work in finishing the cement the power required is approximately 2 h. p. per barrel. In each instance you will notice the conspicuous economy in power effected by this method of reduction, as against that required for previous methods.

The next natural question is, does the Kent mill, as a finisher, maintain the same conspicuous economy of wear account that it has been found to have as a feeder. From the most careful tests and observations it appears that $180 a year is a conservative estimate of the wear cost of the Kent mill as a finisher, but for ultra conservatism let us double this and assume a wear account of $360 per year, or a dollar a day on a Kent mill, grinding 250 barrels per day of finished cement. This gives us a basis apparently twice as disadvantageous as experience indicates probable, and it is easy to calculate on this basis that we have a wear account of four-tenths of one cent per barrel of finished cement. Comparing this with the wear account when the Kent mill is grinding feed, we find that the wear cost increases when the mill is doing all of the work to approximately four times what it was when only part of the work was being done.

While giving these results, we refer to another result recently obtained in using a Kent mill as a fine grinder, and in this you will see wherein we are again indebted to the gentleman of your industry for disclosing to us a point of improvement in the Kent mill. The wear referred to has been that of the wearing parts of the mill, which ordinarily constitute the sole source of wear account, and renewing which should make the mill as good as new, so that the life of the rest of the machine should, barring theoretical deterioration, be well nigh perpetual. In the eight years in which great numbers of Kent mills have been used in many industries, there has been practically no breakage, and were it not for the cement manufacturers, we should to-day believe that the proportioning of the parts of the machine, and the margin of safety allowed in the strength of materials entering into the Kent mill, were correct and ample, basing such belief on these long years of immunity from breakage. It has developed, however, in using the Kent mill as a fine grinder for Portland cement, that the margin of safety in the roll shafts is not as great as it should be to endure the exceptional strain, and therefore that it will be desirable that the strength of these should be increased from 30 to 50 per cent. In fine grinding recently, some Kent mill shafts have been broken, and the breakage of a shaft in the Kent mill is such a rarity that we are immediately concerned, and forthwith are convinced that recurrence of such an accident must be precluded. We all understand that this is a simple matter of diameter, the mere adding of metal, as is common in machine practice wherever extra strength appears necessary; and while this breakage has made it necessary for us, for the time being, to modify the claim that the Kent mill was break proof, we contend that this is so easily remedied that soon it will be again pos-

sible to maintain that we not only have a grinder which reduces horse-power to the nearest possible to that theoretically requisite to overcome the crushing force of the cement, and one which reduces wear account to the absolute minimum necessary to do the work, but we also have one that it break proof.

There is one more interesting development incident to fine grinding with the Kent mill. This is that, while the tests show that the Kent mill finished cement is so much finer than that of the tube mill, there is noticeable to the delicate touch a distinct difference between the two products, in that the Kent mill cement does not feel as velvet-like as the tube mill cement. While, in fact, the particles of Kent mill cement are very much finer than those of the tube mill cement, it is possible to tell the difference by the touch. This is not difficult to account for, as in the primitive operation of slowly rubbing and rolling down the cement in ball and tube mills, just as Nature rolls and rubs down the sand of the sea, the particles are worn off round and smooth like grains of sea sand, whereas in the Kent mill, where there is the minimum of rubbing and the maximum of crushing, the particles are cracked into minute form, but even in their finest condition are sharp, clean and natural. In the Kent mill the cement is fractured so as to expose its nascent surfaces, whereas in the tube mill it is rubbed off and its faces rubbed with foreign matter, and is in a less receptive chemical condition. Whether or not the sharp, clean nascent cement of the Kent mill or the dull, round coated cement of the tube mill is the better chemically, it is not in my province to judge. That is for you to determine. As a general rule, in chemistry, the clean, sharp nascent surface is considered the best for reaction. In cementitious operations, also, it is generally considered that the round, smooth particles are inferior as holding agents, and the sharp, clean particles are the most desirable. This is noticeable, particularly in sand-lime brick-work, where sand can not be used in its round, smooth state, but must be cracked to expose sharp surfaces. It is also noticeable in cement work, where sea sand is objectionable on the ground that it is round and smooth.

CURING OF CEMENT BLOCKS.*

By James Wimmer, Perry, Iowa.

The subject allotted to me for discussion is curing cement blocks. This industry is too new for any one to say this method, or that method, is the only way, so what I will have to say will not be from theory, but will be based on my own actual experience, in treatment of this subject. I, of course, consider nothing but the perfect block. This means sharp, clean sand, good cement, proper proportions, thoroughly mixed, thoroughly tamped, and placed in the shade. A block well made but badly cured, is worthless, and a block poorly made and well cured is worthless, so great care must be taken in all stages of block manufacture. A good product means a good industry, and a good industry means much to us all in this age of progress.

To my mind one of the most important features of block manufacturing is the curing process. A block must cure uniformly. The primal requisite in proper curing is water, and plenty of it. No stated time can be given for beginning the sprinkling, as all depends on the atmospheric conditions. Some days you can begin sprinkling three hours after the block is molded, while at other times five to eight hours will elapse before you can apply water with safety. The moment you detect the face of outer surface turning light, it is a sure sign the blocks need water, and they must be sprinkled as often as this is noticed. You can not make them too wet. This process should continue for at least forty-eight hours, or until the block can be removed from the pallets, lathed and piled. By lathing each tier the blocks dry uniformly. This water cure continues from five to eight days. All of our sprinkling is done with hose and spray, and this is carefully attended to by one man. We have found that blocks can only be successfully cured by one experienced man. What is everybody's business is nobody's business, and the blocks can not and must not be neglected. We have carried out this plan ever since our third day's product was ruined by a blunder, too many men attempting to superintend the water cure. We hear of some people who advocate the process of curing blocks under water. My actual experience tells me this is a failure, for two reasons: First, it is not practical; second, it means extra labor and expenses. Imagine what an area it would require to submerge the product of five days' labor, which means about 600 blocks from the average machine. One can see at a glance this is impractical for the ordinary manufacturer.

To make this a permanent industry, we must have the co-operation of all to learn and know the best methods of block making and curing. There are always some who look upon a new industry with a skeptical eye, so we can not afford to be too eager to place our porduct on the mar-

*A paper before the Iowa Cement Users' Convention.

ket, and allow a green block to be placed in a wall. In these few remarks I have endeavored to give you a definite idea as to the curing of cement building blocks, and in closing, I will raise the finger of doubt, in the next few years you will see all our finest office buildings, and most beautiful residences, and largest factoreis, prophecy and tell you that, without a built with concrete products.

MUNICIPAL AND TECHNICAL LITERATURE

Louisville Water Report—Cleveland Water Works—New Publications.

Louisville Water Works Report.

The annual report of Charles R. Long, president of the Louisville Water Company, was issued June 6. This is the forty-seventh report of the company. It shows that during 1904 the gross amount of bills for water rents was $55,905.03, and the net amount of cash for water rents was $451,121.01. The discounts on bills for prompt payment amounted to $58,480.82.

President Long says the construction of the filter has progressed reasonably well during the year. The Holly Manufacturing Company is now installing the machinery, which will be completed within a few weeks. The Holly company's contract provided that the clear water pumping plant would be in operation on June 1, 1905, but the work was delayed. The total amount paid out up to the present time on account of the filter system is $742,830.24. President Long says that when the filter is completed the company will provide for the city and citizens not only the most desirable water supply of any city in the United States, but under advantages possessed by no other city.

Cleveland, Ohio, Water Works.

In his annual report, Superintendent Bemis, of the water works department of Cleveland, Ohio, declares that the consumer has been benefited by the introduction of water meters, and that the bills of water users in April of 1904 were 76.3 per cent. of their former assessment bills, and in October, 1904, were 63.9 per cent. of the old bills. He states that the water department has also gained from the use of meters, and that from 1900 to 1904 there was a saving of pumpage to the extent of 13,216,000,000 gallons, a saving in cost of $73,349. The report says:

Two great benefits from the meters in 1904 were the saving in human life and the saving of large expenses. Had it not been for the meters the consumption of water would doubtless have increased as fast during the last four years as during the preceding four years, instead of actually diminishing. It would have been impossible, during the months of January, February and March to have pumped much more than actually was pumped at the Kirtland street station. At least one-fourth of the water supply on the average, and over one-third on some days, would necessarily have been taken from the old intake had the water meters not reduced the consumption. It is natural to suppose that at least one hundred deaths and one thousand cases of typhoid would have occurred under this condition.

Mr. Bemis says in regard to the saving of expense that at the time of the typhoid epidemic it would have been a physical impossibility to increase the pumping capacity of the Kirtland street station or to extend the West Side tunnel to furnish a better water supply, and he figures that to keep up with the heavy demands made upon the department before the meters were installed, $800,000 would have had to be spent before relief could have been obtained.

Speaking of the consumption of water in the city, the report states that the daily per capita has fallen from 172.2 gallons in 1901 to 138.6 gallons in 1904.

The consumption of water during the year in the city as a whole increased 0.43 of 1 per cent. In the low service there was a decrease of 2.43 per cent. and in the high service the large increase of 21.21 per cent. This latter increase was partly due to the annexation of terri-

tory from the low service and the increased pumpage of water from the high service into the suburbs, but in part it was due to an increase of waste which fortunately was checked at the beginning of 1905. The high service, however, will for many years grow much faster than the low service, and its reinforcement will require much attention.

New Publications.

Reinforced Concrete. By Charles F. Marsh. 545 pp. 512 illustrations and diagrams. Cloth. $7 net. D. Van Nostrand Company, 23 Murray street, New York City.

Mr. Marsh presented this book as the first of its kind in English, as a result of his studies in introducing reinforced concrete into England. The building regulations in that country not having been modified to permit economical construction on the new system, there are few English examples in the book, nearly all being taken from practice in France, Germany and the United States. The author acknowledges his indebtedness to the French books upon the same subject. He has done very notably good work for a first book upon so intricate and so unknown a subject, and must be commended for his earnest effort to show the advancement in this line and the methods of applying the knowledge which has been gathered. His effort seems to have under the surface, and not expressed, the object of informing the English public upon the value of reinforced concrete construction, that the building regulations may ultimately be changed to permit such work in English cities. He certainly makes a good case, and presents reasonably good answers to the questions that may be asked and the objections that may be made by engineers, building superintendents and municipal officials whose conservatism makes them slow to change.

The first paragraphs give excellent reasons for using the term "reinforced concrete" rather than the various combinations of the words, steel, iron, concrete, and their synonyms. The introductory chapter also contains a short history of the development of the use of reinforced concrete and the regulations in various cities of Germany, Austria, Switzerland and the United States, governing the use of the system, as well as concise statements of its advantages in resisting fire, protecting the steel from rust, impermeability, durability, appearance, economy, solidity, ease and rapidity of erection and general adaptability. It also calls attention to the doubtful and unsettled questions of calculation, care in handling forms and expertness in designing.

Part II describes the various systems of reinforcement employed, diagrams and illustrations showing the general principles of the application of steel reinforcement and the peculiar characteristics of nearly fifty systems, arranged alphabetically by the name of the originator.

Part III considers in a rather general way the materials to be used, cement, sand, gravel, broken stone and cinders, and their proportions and method of mixing. There are a few words also about the qualities of the reinforcing steel. This subject is somewhat aside from the main object of the book and is not treated fully, there being other books devoted more fully to it.

Part IV is devoted to the description of practical methods of construction, including molds, falsework for columns, walls, beams, floors, arches, sewers, tunnels and chimneys, the treatment of the reinforcing metal including the placing of each of the prominent proprietary forms of bars and networks and their combinations. This chapter is fully illustrated, but there are so many descriptions that many of them are necessarily short. A very good selection of systems to describe has been made.

Part V gives a statement of the results of experimental research up to the time of publication of the book. There is so much activity in this line that this section of the book was behind the times before it reached its first readers. This will doubtless be true of any book on this subject which may be issued at any time within the next five or ten years.

Part VI is by far the longest chapter in the book. It is devoted to methods of calculation, and the same remarks may be made about this discussion as about the reports of tests, except that the new methods of computation do not appear as rapidly as the reports of tests. The hypotheses on which the discussion is based are perpendicularity of forces to the neutral surface in bending, independence of action of fibers, solid contact between reinforcement and concrete, cross-sections remaining plane surfaces during loading, no initial stresses from setting or temperature changes, coefficient of elasticity varying according to parabolic law, elongation of concrete not to exceed 1 in 1,000, and no tensile resistance in concrete. Standard formulae for moments and stresses are derived and applied to the case of reinforced concrete construction for rectangular and T beams, pipes, circular reservoirs for pressure from within and without, arches of various forms and sizes, spherical and conical coverings. There is not yet sufficient knowledge of the action of reinforced concrete to make possible uniformity in assumptions or in conclusions, so that many

engineers will not accept the author's statements. The results seem to be on the safe side, and this is desirable until we have more data on which to base determinations of constants and theories of resistance of the combined materials to strains.

Part VII gives illustrations and very brief descriptions of about sixty structures in reinforced concrete, from troughs for electric cables to warehouses.

Appendices give the results of Considere's tests to destruction of a reinforced concrete bowstring truss bridge, 65.6 feet long, the members being of hooped concrete; methods of preventing leakage through concrete, and descriptions of a number of reinforced concrete structures in India.

The book is very satisfactory as a first book on a new subject, and is likely to be for some years the standard authority in its line, until the many experiments, some of which have been reported upon since the book was issued, bring more order out of the chaos which it will do much to reduce to form.

Self-Propelled Vehicles. A practical treatise, with illustrations. By J. E. Homans, A. M. 8vo. 672 pp. Bound in black vellum, gilt top, gold tities. $2. Theo. Audel & Co., Educational Booksellers, New York.

In presenting the new edition of this work the publishers announce that the book has been thoroughly revised, and in large part rewritten.

There is a vast amount of useful information packed into its 644 pages, and it is so well arranged and so clearly stated that the reader cannot fail to find and comprehend the information given.

The general principles of automobile construction and operation, including steering devices, underframes, wheels, tires, bearings, lubricators, are included in the opening chapters. Then follows an exhaustive account of the theory, construction and operation of gas engines, occupying over one hundred pages. Several typical engines are taken up and discussed separately, and their properties, as regards balance, speed and power, are discussed in the light of fundamental principles. The explanations of the governing devices are clear and valuable, while the discussion of ignition, including the hot tube and the primary and secondary sparks, cannot fail to prove of the utmost value.

Probably the most interesting feature of the entire work is the extensive chapter devoted to the description of leading types of gasoline vehicles, including the most important of American build. In this chapter the reader is informed as to the details of the transmission and control apparatus in each case. The chapters on electric vehicles are also full and certain to prove of practical use to the owner and chauffeur. Taking the subject of electrical apparatus from the fundamental principles of circuits and batteries, the discussion passes to the theory and operation of generators and motors; the laws of motor operation; the laws involved in computations of speed and power, and the varieties of motor suited to road carriages. Electricity meters are described and illustrated in a brief chapter, and the principles underlying storage batteries, their construction and care, are outlined.

All necessary information is given, and the merits of several types of steam carriage are fully set forth.

The book closes with a chapter on "Gasoline Vehicle Management," excellent for its completeness and "useful hints;" another on gasoline cycles that covers the general principles involved in this type of motor.

An exceedingly full index at the close of the book puts its contents into "ready reference" shape, an advantage of no small importance in view of contingencies sometimes happening in the use of the 'mobile.

Modern Practical Electricity: Electricity in the Service of Man. A popular and practical treatise on the applications of electricity in modern life. By R. Mullineux Walmsley, D. Sc. In four volumes. 1,208 pp. Cloth. $12 net. W. T. Keener & Co., 90 Wabash avenue, Chicago, Ill.

The author of this work is the head of the electrical engineering department of the Northampton Institute, London, Eng., and he has apparently prepared it as a good general statement of the status of the art of applying electricity to use. A condensed abstract of the table of contents will show the scope of the volumes.

Part I occupies more than two of the volumes, 690 pages, and considers the history and principles of electrical science. The introduction gives a short sketch of the early history of electricity and electrical apparatus, and more particularly of magnetism. Then follow chapters on the principles of magnetism and electrostatics and a series of chapters on the electric current, the elementary laws of simple continuous currents and their chemical, thermal and magnetic effects. Electro magnets are treated in a short chapter, and magneto-electric induction. The principles of simple measurements are clearly stated. The telegraph and the telephone each has a chapter. The dynamical or magnetic production of current, alternating currents, the electric transmission of power, electric motors, alternating current measurements and the electric discharge are subjects of other chapters in this part.

The second part, completing the four

volumes, is devoted to the technology of electricity. Continuous current generators, alternators, the magnetic circuit, batteries of generators, continuous and alternating current motors, dynamo and motor testing and apparatus for electrical measurements are illustrated and described. The examples are taken from English practice, but as the principal American manufacturers have branch houses or manufacturing or sales connections in England, American practice is also fairly well represented.

It will be seen from this brief resume of the contents that the work does not attempt to cover all the applications of electricity, even in the field of power. Being popular, it does not go far into the theory of electricity, and there are but few equations or developments of theoretical discussions. Being practical, it describes examples of good practice and is very fully illustrated with drawings, diagrams and photographs of apparatus and parts of apparatus, separately and installed for use.

The books will doubtless be very useful to a large class of men who are not expecting to be engaged in the design of electrical power apparatus, but who must know what has been done and what can be done in this line, and must understand enough of the principles to enable them to do their work in putting the apparatus to the uses for which it is intended. It is difficult to prepare a book on so large a subject which will steer clear of the abstract and abstruse matters which the practical man has no desire for, and at the same time give enough of the principles upon which the design of the machines is based to enable the practical man to work with a reasonably good understanding of what he is doing and why he is doing it. So far as the writer can judge, the author has succeeded very well in his endeavor to meet the needs of the large number of men engaged in electrical construction to which this description ap-

Roads, Their Construction and Maintenance, with special reference to road materials. By Allan Greenwell, A. M. I. C. E., and J. V. Elsden, B. Sc. 280 pp. Cloth. 5 shillings. Whittaker & Co., London and 66 Fifth avenue, New York City.

As an English book the discussion of road materials is more particularly applicable to the road materials of England, but the principles underlying the choice of road materials are well developed and will serve as a guide for the study of materials found in other countries. Seven chapters are devoted to the materials for macadam roads, one to artificial stone and brick, one to asphalt and tar, one to wood and methods of preserving it. The last three chapters are short, and, quite naturally, do not contain references to recent American progress in the application of all of them.

The methods of testing road materials are well set out in one chapter.

The section of the book devoted to construction gives a historical view of macadam roads, the principles underlying the selection of a route for a new road, the details of laying out and computing quantities, methods of drainage and appliances therefor, and the wearing surfaces of roads. It also treats briefly such paving materials as concrete macadam, tar macadam, the foundations and wearing surfaces of brick, wood, asphalt and other pavements. The conditions of wear and the relations of materials and methods of construction are treated at some length, the advantages of thorough rolling being very fully set forth.

The third part of the book, about fifty pages, is devoted to maintenance. The influence of wheels, width of tires, gradients and conditions of surface are compared. Perhaps the most valuable part of the book for American engineers is the section giving full instructions as to methods of repair and cleaning of macadam and gravel roads and pavements, though it is all crowded into two chapters. The book contains two chapters on cost of road construction and of pavements, not very valuable to American engineers, but indicating what could be done in this line. Few books on engineering construction except the very latest pay proper attention to this important subject. Professor Baker, and, to some extent, Mr. Tillson are exceptions in the field of road engineering.

Electric Railway Directory and Buyers' Manual. Issued in February, August and November each year. McGraw Publishing Co., New York City.

Each issue of this directory contains a list of the street railway and electric interurban lines, arranged alphabetically by States and cities in which the main offices are located. Names of officers and data regarding equipment are given for each line. Signs show the companies furnishing new information since the last issue and what are new companies, also the date of the latest information printed. The number of these signs is evidence that the list is kept very closely up to date. There are also lists of the officers of street railway associations, names of National and State railroad commissioners, and an alphabetical list of street and interurban railway officials, with references to their companies.

The May issue of this directory is combined with the annual Red Book, American Street Railway Investments, issued by the same company.

Handbook on Sanitation. A manual of theoretical and practical sanitation for students and physicians; for health, sanitary, tenement house, plumbing, factory, food and other inspectors; as well as for candidates for all municipal sanitary positions. By George M. Price, M. D., medical sanitary inspector, Department of Health, New York City. 316 pp. Cloth, $1.50 net. John Wiley & Sons, New York.

This is a second edition of a book which was reviewed in MUNICIPAL ENGINEERING vol xxii, p. 183, and so far as the same material has been used, the criticisms there made are still pertinent. The author states in his preface to this edition that he has omitted all material of merely local application, including the sanitary law of the city of New York, has enlarged the part devoted to sanitary inspection, and has rewritten the part on sanitary practice in dwellings, factories, foods and disinfection.

The first part, which much needed revision to bring it down to modern practice, has not been changed except by adding a few unimportant extracts from Chapin's "Municipal Sanitation," giving very insufficient information on the subjects they touch, and even carries the same typographical and grammatical errors which appeared in the first edition.

The second part is very much improved and gives a satisfactory brief statement of the urban conditions in tenement houses, dwellings, factories and workshops, the laws regarding supervision and inspection, and the methods of controlling the construction and sanitation of the structures named, including light, plumbing, heat and ventilation of tenements, dwellings, factories and workshops and bakeries, and of controlling offensive trades making noise, smoke, dust and smells. It also considers the inspection of foods, having chapters on meats, milk and dairy products, cereals vegetables and fruits, food preservation and adulteration, and giving forms for reporting results of inspection. Physical, gaseous and chemical solution disinfection are treated briefly, but quite effectively.

The third part, in addition to the material brought over from the first edition, gives some information about the extent of sanitary inspection in American cities, and gives full sets of questions which have been used in examinations of applicants for positions as sanitary inspectors in the city of New York.

The omission of the sanitary law of the city gives room for the addition of the new material described above and perhaps adds to the value of the book for other localities, though the opportunity to obtain readily a copy of the law in book form was of distinct value in the first edition.

Central Station List and Manual of Electric Lighting. Quarterly. $4 a year. McGraw Publishing Co., New York.

The latest issue of this book is that for March, 1905. It contains condensed information regarding central electric stations throughout the United States, including population of city, name and ownership of station, capitalization, cost, bonded indebtedness, names of officers, list of equipment, terms of municipal contract, cost of coal, etc. The list occupies about three hundred pages, and about twenty-five pages additional are devoted to matters of interest in the field, such as the proceedings of the conventions of the National Electric Light Association, statistics on electric light and power, news notes, etc. The date at which the information was received from each company is indicated by a number following the entry for the company.

Reinforced Concrete. Part I, Methods of Calculation by A. W. Buel. Part II. Representative Structures and Part III. Methods of Construction, by C. S. Hill. 434 pp. Cloth, $5. Engineering News Publishing Co., New York City.

This book is a compilation of material which has appeared in print upon the subjects which it treats, and, as this method of construction is new and its theory is not yet well established, the discussions have been based upon various principles and lead to quite various results. The authors have not taken th time to work out the various problems and bring them to a common basis and as a consequence the statements made in various parts of the book are very far from agreement. The writer has not taken time to hunt out these discrepancies to any great extent, but the following, to which his attention has been called, will illustrate the necessity of taking great care in accepting any equation or table without definite knowledge of its accuracy derived from other sources or by comparison with other results of know reliability given in the book. Thus, if one refers to the discussion of modulus of elasticity beginning on page 8, he will find safe ground and definite reason for variations given, but elsewhere in the book he will find values varying from say 700,000 to 7,000,000 without warning as to the safety of accepting them for other conditions.

Again the formulae for strength of beams developed on page 19 and those following bring out on page 23 for a specific case a value of the moment of resistance of 43,602 inch pounds. Tables computed from Thacher's formulae immediately follow, and on page 23, for 10-foot span it will be seen that the bending moment which a beam of this cross section will carry is 102,800 inch pounds

The latter value is very close to the results of actual test with the assumed factor of safety of 5.

The tables and formulae are in fairly convenient form, and, after they have been properly checked and the incorrect ones crossed out, will be of value to the engineer engaged in this class of work. Beams, columns, retaining walls, dams, tanks, conduits, chimneys and arches all have some share of attention.

The second part shows many of the more prominent forms of reinforced concrete construction as they have been worked out by their inventors and other engineers, including various forms of foundations. Floors, columns, walls and roofs, bridges, arches and culverts, aqueducts, conduits, sewers and subways tanks and reservoirs, retaining walls, cross ties, chimneys, tunnels, bridge piers, lighthouses, dams, etc., and is very valuable as a collection of such descriptions.

The third part is a brief statement of the methods of construction including descriptions of the various materials used, concrete metal fabrics, rods and bars. The consideration of concrete is exceedingly brief and incomplete. A good idea of forms and methods of placing concrete for the various classes of construction can be gained from the chapters of this part. The question of facing concrete is considered in the closing chapter and the present rather unsatisfactory state of the art of making a good permanently handsome surface is set forth.

ORGANIZATIONS AND INDIVIDUALS

The American Society of Civil Engineers—Lehigh University—The American Society of Municipal Improvements—The League of American Municipalities—The Cement Machinery Manufacturers—Technical Meetings—Personal Notes.

The American Society of Municipal Improvements.

The desirability of an association of city officials for united and systematic consideration of the affairs controlled by and relating to municipal corporations had been the source of much favorable theoretical discussion, but numerous difficulties appeared to prevent the practical application of the theory until the question was taken in hand in the summer of 1894, by Mr. M. J. Murphy, at that time street commissioner of St. Louis, Mo., U. S. A. The persistent efforts and extended correspondence by this gentleman, assisted by the officials of Cincinnati and Buffalo, resulted in a call for a meeting of interested cities on September 19, 1894, at Buffalo, N. Y., for the purpose of effecting an organization of the officials representing both the legislative and executive branches of urban administration.

The general interest in such matters was indicated by the large representation of cities at this initial meeting. About sixty delegates from the following sixteen cities were in attendance and assisted in perfecting a permanent organization: Allegheny, Pa., Buffalo, N. Y., Camden, N. J., Cincinnati, O., Fort Wayne, Ind., Grand Rapids, Mich., Indianapolis, Ind., St. Louis, Mo., Memphis, Tenn., Milwaukee, Wis., Newark, N. J., New Bedford, Mass., New Haven, Conn., Omaha, Neb., Portland, Me., and Syracuse, N. Y.

The result of this meeting was the formation of the American Society of Municipal Improvements, the first practical association of any magnitude in America ever perfected for the consideration of city affairs. The agitation of leading municipal problems by the public press for two or three years immediately prior to the meeting at Buffalo had awakened the public interest in public affairs, and developed a general conviction of the necessity for the united effort in devising improved and businesslike methods in the conduct of affairs common to all. The movement, therefore, was launched at a most propitious time, as it met the full approval of the general public, and the stimulus imparted by such favorable conditions placed the society upon a sound and thriving basis, upon which has de-

veloped a steady, healthy growth in numbers and usefulness.

The society was organized on broad lines, and its field of operation embraces every department of a municipality, with particular attention to taxation, government, sanitation, lighting and public improvements. It binds together for a common purpose the executive heads of the various departments, together with the mayors and councilmen, who are responsible for the general policy to be pursued.

It is the aim of the association to bring these officers together during the fall of each year for the purpose of considering, through papers, discussions and committee reports, all questions relating to the best interests of American and Canadian cities; to promote social and friendly intercourse at such conventions and to circulate the information thus obtained among its members through the publication of the proceedings in pamphlet form. By these means the society endeavors to secure a thorough study of municipal affairs, the dissemination of information relating to same, the promotion of official efficiency and an honest and capable administration of all city departments.

A considerable benefit is derived also by the delegate through the opportunity to visit the cities selected as the places for meeting and examine the public works of same. These cities represent the most progressive elements of municipal practices and government and much can be learned by a personal investigation of their methods. The meetings have been held in the following locations:

1894, Buffalo, N. Y.; 1895, Cincinnati, O.; 1896, Chicago, Ill.; 1897, Nashville, Tenn.; 1898, Washington, D. C.; 1899, Toronto, Ont.; 1900, Milwaukee, Wis.; 1901, Niagara Falls, N. Y.; 1902, Rochester, N. Y.; 1903, Indianapolis, Ind.; 1904, St. Louis, Mo.

The next meeting of the association will be held in Montreal, Que., on September 5, 6 and 7, inclusive, for which a valuable and interesting programme has been prepared by the officers of the society and the local committee of citizens. In connection with this meeting the associate members of the society have decided to hold the first annual exhibition of municipal supplies, in the Crystal Rink, corner of Dorchester and Guy streets, on September 5 to 9, inclusive.

The meeting of the convention will be held in a part of the Crystal Rink especially reserved for that purpose.

Some forty or fifty new memberships among the cities not heretofore represented in the society have been secured already through the efforts of the executive committee, under the efficient guidance of President A. P. Folwell, of Easton, Pa., and others are taking the necessary steps.

The local arrangements for the Montreal convention are in the hands of a local committee, of which John R. Barlow, second vice-president of the society, and Alcide Chaussee, chairman of its finance committee, are prominent members. September is the best month for a visit to Canada, and everything points to a successful and valuable meeting, with large attendance. Those who are not already members of the society and are interested in municipal improvements should write at once to Secretary Geo. W. Tillson, Municipal Building, Brooklyn, N. Y., for information about the convention details and blank applications for membership.

The American Society of Civil Engineers.

The thirty-seventh annual convention of the American Society of Civil Engineers was held in Cleveland June 20 to 23, inclusive, over 500 members and visitors being present. An attractive program of entertainment was offered by the local committee, including a drive through the parks, a meeting for the description of local industries visited in detail in separate parties afterward, two receptions and an all day excursion by steamer to Lorain to visit the factories and railroad terminals.

There was no program of addresses and papers, aside from the president's address, but the committee meetings held on Wednesday and Thursday will be productive of much good to the engineering profession.

Lehigh University Register.

The Register of Lehigh University, South Bethlehem, Pa., just issued, copies of which may be had on application, shows the attendance of 630 students from twenty-four States and eight foreign countries, the largest in the history of the institution. There are fifty-six in the teaching staff. Two hundred are taking the course in civil engineering.

Thirteen four-year courses of instruction are offered at the university: The classical course, the Latin-scientific course, the courses in civil, mechanical, marine, metallurgical, mining, electrical and chemical engineering, analytical chemistry, geology, physics and electrometallurgy.

A list of graduates of the university, with their present occupations, 1,399 in number during the thirty-nine years of its existence, indicates that this institution is exerting a marked influence on the

industrial development of the United States and of foreign countries.

Provision is made for worthy and needy students whereby they may postpone payment of tuition until after graduation.

The League of American Municipalities.

The following is the programme for the ninth annual convention of the League of American Municipalities, to be held at Toledo, Ohio, August 23, 24 and 25, 1905, so far as it has been completed:

President's address.

"Municipal Finance and Accounting," by L. G. Powers, Chief Statistician, Department of Commerce and Labor, Washington, D. C. Discussion led by Louis Betz, Comptroller, St. Paul, Minn.

"St. Louis' Municipal Lighting Plant," by J. W. Wood, Chief Engineer, St. Louis, Mo.

"How to Tax Real Estate," by Hon. Peter Witt, City Clerk, Cleveland, O.

"Workhouses," by Frank R. McDonald, Superintendent Minneapolis City Workhouse.

"Municipal Ownership," by Hon. Robt. H. Jeffrey, Mayor, Columbus, O.

"Street Railway Situation in Toronto," by F. S. Spence, member Board of Control, Toronto, Canada.

"Abatement of the Smoke Nuisance," by R. P. King, Smoke Inspector, Indianapolis, Ind.

"Should Disinfectants Be Standardized?" by Wm. S. Crandall, New York City.

Address by Oscar Leser, Judge Appeal Tax Court, Baltimore, Md.

"Factors in Asphalt Paving Construction, Maintenance and Cost," by Andrew Rosewater, City Engineer, Omaha, Neb.

Address by Chas. A. Hague, C. E., New York City.

Other speakers are to be announced. Exhibits by manufacturers and dealers in municipal machinery and appliances will be an attractive feature of the convention. Applications for space should be made to J. W. Flowers, chairman committee, Toledo, Ohio.

The Concrete Block Machine Manufacturers.

The manufacturers of concrete block machines met at the Great Northern Hotel, Chicago, June 27 and 28, and organized an association. As MUNICIPAL ENGINEERING goes to press the association is in session. The foloiwng program was arranged by S. L. Wiltse, of the Cement Machinery Company, of Jackson, Mich.:

"The Position of the Block Machine Manufacturer Relative to the Public"—O. W. Miracle, Miracle Pressed Stone Co., Minneapolis, Minn.

"The Manufacture of Concrete Blocks," sub-divided as follows: (1) Raw Materials best to use, their mixing; (2) Tamping, Pressing and Pouring; (3) Handling and Curing; (4) Standard Designs—M. Wetstein, Ideal Concrete Machinery Company, South Bend, Ind.

"Building Laws and Inspection for Concrete Blocks"—N. B. Marple, the Hayden Automatic Block Machine Co., Columbus, Ohio.

"Architecture of Concrete Block Buildings"—Frank Dykeman, K. Dykeman & Sons, Grand Rapids, Mich.

"My Experience"—Noyles F. Palmer, Noyes F. Palmer Mfg. Co., Brooklyn, N. Y.

"The Factory and Foundry"—Levi P. Normandin, Cement Machinery Co., Jackson, Mich.

"Terms of Sale of Block Machinery"—J. F. Angel, Winget Concrete Machine Co., Columbus, Ohio.

"Concrete Block Insurance"—Sid. L. Wiltse, Cement Machinery Co., Jackson, Mich.

"Your Machine Expert"—J. M. Hagerman, Contractor, Winchester, Ind.

"Standard Lengths, Widths and Heights of Concrete Blocks"—E. L. Peek, Stringer Machine Co., Jackson, Mich.

"What the Underwriters and the National Fire Protection Association are Doing for us from an Insurance Point of View on Concrete Blocks"—E. T. Cairns, chairman Committee on Cement for Building Construction, apointed by the National Fire Protection Association, Chicago, Ill.

"Fireproofing of Concrete Blocks, as compared with Brick, Stone, Terra Cotta and Lumber"—O. H. Sweeney, Waterloo Concrete Block Co., Waterloo, Iowa.

"Trade Journal Advertising" (limited to ten minute talks by representatives of various publications).

"Concrete Blocks as Building Material"—L. Pettyjohn, Pettyjohn Bros., Terre Haute, Ind.

"Reading of papers furnished by the cement manufacturers in behalf of the concrete block industry."

"The Coloring of Concrete Blocks"—J. P. Scherrer, National Building Block Machine Co., Milwaukee, Wis.

"Plastering and Lathing to Concrete Blocks"—J. W. Shone, Century Cement Machine Co., Rochester, N. Y.

"Freights on Concrete Block Machinery and Concrete Blocks"—J. W. Sanderson, Cement Machinery Mfg. Co., Burlington, Iowa.

"The Architect"—P. B. Miles, the P. B. Miles Mfg. Co., Jackson, Mich.

"The Traveling Salesman"—A. L. Boughton, Standard Sand and Machine Co., Cleveland, Ohio.

Technical Meetings.

The American Society for Testing Materials, the Pacific Coast Engineering Congress and the Pacific Northwest Society of Engineers held their meetings June 29 and 30 and July 1.

The annual convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 23, 24 and 25. F. P. Foster, sec'y., Corning, N. Y.

The annual meeting of the American Public Works Association will be held at Chattanooga, Tenn., August 30 and 31. W. H. Flint, sec'y., Chattanooga.

The organization of the National Assocation of Paving Brick Manufacturers was completed at a meeting held in Cincinnati on May 25. The first meeting was held April 27. Officers were elected as follows: President, W. P. Blair, Terre Haute, Ind.; vice-president, W. S. Purington, Galesburg, Ill.; treasurer, Charles N. Crook, Youngstown, Ohio; secretary, Spencer M. Duty, Cleveland, Ohio. The association is made up practically of the paving brick men of Ohio, Indiana and Illinois.

The annual convention of the American Institute of Electrical Engineers was held at Asheville, N. C., June 19 to 23. The program included the following papers: "Appalachian Water Powers," F. A. C. Perrine; "Three-Phase Traction," F. N. Waterman; "Limits of Injurious Sparking in Direct Current Commutation," Thorburn Reid; "A Study in the Design of Induction Motors," C. A. Adams; "Choice of Motors in Steam and Electrical Practice," William McClellan; "High-Potential Oscillations of High Power in Large Power Distribution Systems," Charles P. Steinmetz; "The Constant Current Mercury Arc Rectifier," Charles P. Steinmetz; "Heavy Electric Freight Traction," C. De Muralt; "A New Instrument for Measuring Alternating Currents," E. F. Northrup; "Motor-Generators and Rotary Converters," W. L. Waters: "Limits in Direct Current Machine Design," Sebastian Sonstius; "Electrical Features of Block Signaling," L. H. Thullen: "The Development of the Ontario Power Company," P. N. Nunn; "A New Induction Generator," William Stanley; "An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances Due to Switching, Grounding, etc," Percy H. Thomas; "Experimental Data Relating to Conductors and Underground Electric Cables," Henry W. Fisher; "Methods of High-Pressure Measurement," S. M. Kintner; "Weight Distribution on Electric Locomotives, as Affected by Motor Suspension and Draw-Bar Pull," S. T. Dodd; "Eddy Currents in Large Armature Conductors," A. B. Field.

The directors of the Northwest Cement Products' Association have decided to hold the next annual meeting of the association in Minneapolis early in January.

The National Electrical Contractors' Association will hold its convention and exhibit in Boston, July 15 to 22.

The fifth annual convention of the National Good Roads Association was begun at Portland, Ore., June 21. W. H. Moore, president of the association, called the convention to order, and then reviewed the work of the association during the time of his official connection with it and the work accomplished. The annual report was submitted by Col. R. W. Richardson, secretary of the association.

The fifty-first convention of the American Society of Mechanical Engineers was held at Scranton, Pa., June 6, 7, 8 and 9. Some of the papers submitted were as follows: "Can a Steam Turbine be Started in an Emergency Quicker than a Reciprocating Engine of the Same Power?" A. S. Mann; "Counterweights for Large Engines," Prof. D. S. Jacobs; "Steam Actuated Valve Gear," W. H. Collier; "Notes on Efficiency of Steam-Generating Apparatus" and "Performance of a Superheater," A. Bement; "Cast Iron; Crushing Loads and Microstructure," W. J. Keep; "Notes on Heads of Machine Screws," H. G. Reist; "Continuous Measuring and Mixing of Crushed or Powdered Materials in Accurate Proportions," E. N. Trump; "Standard Units of Refrigeration," F. E. Matthews; "Some Types of Centrifugal Pumps," William O. Webber; "Belt Creep," W. W. Bird; "Function of Laboratory Courses in the Curriculum of Engineering Schools," C. E. Lucke.

The Brooklyn Engineers' Club gave its eighth annual dinner to the ladies at the Park Inn, Rockaway Park, on June 29.

The twenty-eighth convention of the National Electric Light Association was held at Denver, Col., June 6, 7 and 8, and Colorado Springs, June 9, 10 and 11.

Personal Notes.

Thomas C. Thornton has been elected mayor, at Warrenton, Va.

G. H. Kimball has resigned as assistant city engineer of Little Rock, Ark.

Howard Scott Webb, M. Am. Inst. E. E., Professor of Electrical Engineering at the University of Maine, died June 12, of acute tuberculosis.

E. F. C. Harding has been appointed city engineer at Jefferson City, Mo.

R. O. Danenjower has been appointed city engineer, at Little Rock, Ark.

John W. Hackney has been re-elected city engineer at Atlantic City, N. J.

Fred W. Gow has resigned as superintendent of water-works and sewers, at Medford, Mass.

C. S. Alverson has been appointed superintendent of the water department, at San Diego, Cal.

Charles T. Hayden has resigned his position as superintendent of the water and sewer board, at Rome, N. Y.

W. A. Blanck has established an office for consulting electrical engineering practice in the Fisher Building, Chicago.

W. Muir Edwards has been appointed professor of engineering in New Brunswick University, at Fredericktion, N. B.

Morris R. Sherrerd, formerly engineer of the water department, Newark, N. J., has been appointed chief engineer and city surveyor of that city.

W. A. Clement has been appointed city engineer, at Vancouver, B. C. Mr. Clement has been connected with the engineering department of the city of Toronto, Ont., for some time.

Thomas F. Cushing has established an office in the Fuller Building, New York City, under the name of the Thomas F. Cushing Co., and will sell steam, gas and engineering supplies.

Edward A. Leslie, general manager of the King's County Electric Light & Power Company, New York City, died at his home in Brooklyn, June 6, of pneumonia and pleurisy, aged 64 years.

Harry L. Weber has resigned his position as city engineer at Richmond, Ind., and accepted a position as chief engineer of the Fort Wayne & Wabash Valley lines, and also, the Fort Wayne, Logansport and Lafayette city traction lines and light plants.

James Mansergh, past president of the Institution of Civil Engineers and a member of the Council of the Institution of Mechnical Engineers, died in London, Ont., June 15. Mr. Mansergh was connected with various engineering works in the United States and Canada.

Wm. F. Morse, consulting sanitary engineer, has opened an office at 18 Broadway, New York, and will pay special attention to methods of collection, sanitary treatment and disposal of waste from municipalities, institutions and factories, and the design and installation of disinfecting apparatus.

Mr. J. A. Sutton, of Indianapolis, has been employed to audit the books of the water works, electric light and power plant of Austin, Texas, for the past three years, and to instal the American Water Works Standard Bookkeeping System, published by Municipal Engineering Company.

Ira W. Sylvester has been re-elected city engineer at Alexandria, La. Mr. Sylvester is now serving his third term, of two years each, in this position. The June number of MUNICIPAL ENGINEERING stated that Frank Shutts had been appointed city engineer at Alexandria, which was an error.

MACHINERY AND TRADE

Steam Ejectors.

The Marty ejector, or steam syphon, is a jet pump which has proved itself very convenient for many kinds of work where liquids must be lifted under difficult conditions. Thus one general contractor reports the extreme ease and handiness with which it can be put into position for lifting water, sand and mud in sewer work. He reports having a 2½-inch ejector, which is lifting water 45 feet under a pressure of 90 pounds.

The ejector is made in various sizes, and is in use in chemical village fire engines, and in spray, fire, power, chemical and boiler test pumps, as well as for contractors' purposes, as in sewers, stone quarries, foundations and other excavations.

The ejector is made by J. M. Marty, 59 South Water street, Cleveland, O., of whom inquiry should be made for sizes, prices and methods of installation.

Some Recent Garbage Crematories.

The garbage crematory constructed by the Municipal Engineering Company, of New York, to burn the refuse of the United States army post on Governor's Island, in New York harbor, is of the iron-clad type, with hollow triangular revolving grates in two tiers, an upper and a lower, to give ample surface for drying and stoking. Provision is made for two auxiliary fires, one on each tier of grates, but at Governor's Island no fuel other than the refuse of the post is required, and the garbage is burned on all of the grates at once.

The garbage of the post is delivered near the crematory in a water-tight iron cart, which dumps its contents into an iron bucket, set in a sump, so that the top of the bucket is on a level with the driveway. The bottom of this bucket is perforated, permitting the liquid to drain off to a sewer. The bucket holds about

two cubic yards, and when full is hoisted by one man, using a triplex chain block, and run on an overhead track to a point above the crematory, into which it is dumped. About one and a half tons of garbage is thus handled at once, and it requires about four hours to burn one such charge. The plant is operated by military prisoners.

A similar plant was installed to burn the garbage and refuse of the United States army post at Fort Leavenworth, Kans., where about 4,000 persons are quartered.

The garbage is dumped into the crematory through holes in the floor of the receiving room, through which wagons and carts may drive. This floor is paved with brick, and the dump holes, of which there are six, are covered by heavy iron "turtle-back" lids, over which the heaviest wagons may drive with safety. The crematory is used to burn not only garbage, but also manure and other refuse. It has burned sixteen or eighteen tons of manure in a day without other fuel. During the autumn large quantities of leaves, gathered from the streets and lawns, brought to the crematory for consumption, furnish more than the necessary quantity of fuel to consume the garbage, but during the winter little other than kitchen garbage is brought.

The garbage is collected from the various kitchens and conveyed to the crematory in water-tight iron carts. It always contains enough water to be sloppy, and during the winter arrives at the crematory in a frozen condition. Soft coal is used in the auxiliary fires during the winter.

Recently, during the coldest weather, a burning test was made to determine the amount of garbage the crematory would burn when operated to its full capacity. In this test, kitchen garbage was dumped into the crematory for seven days without any fires being kept up. At the end of this time the accumulation was burned and the water evaporated from the ash pits in two hours and twenty minutes.

By actual measurement, before the fires were started, there were consumed in this time 160 cubic feet of kitchen garbage, which was in a partially frozen condition at the beginning of the test. The consumption was, therefore, at the rate of 69 cubic feet per hour, or about 4,000 to 5,000 pounds (two to two and one-half tons) per hour, including the water evaporated in the pits. There is not garbage enough at the post to make a more extensive test, but this rate would be exceeded on a longer run. Two and one-half tons per hour is twenty tons per day of eight hours.

The specifications called for a capacity of four tons of garbage and eight tons of manure per day, hours per day not stated.

This crematory is operated in connection with a sewage purification plant, and the building was therefore built larger than necessary for a crematory alone. The chimney was built large enough to meet the requirements of an electric lighting plant to be constructed at some future time.

These plants are both of the iron-clad type, the covering being of cast iron panels of standard widths, with 9-inch firebrick lining. There are two sets of grates forming the drying and stoking floors. On each level are one or more grates for coal fuel in case it is needed for drying and consuming wet garbage, the number of grates so used depending on the capacity of the furnace and kind of refuse. Alternate sections of the drying floor are revolvable, dumping the dried garbage upon the combustion grates below. Convenient stoking doors are provided for reaching all parts of the furnace. The combustion chamber is notable for its clear space, giving straight and smooth passage for the heated gases of combustion from end to end of the furnace.

Single cells are made with from four to nine sections, each with burning grate and ash pit. Large plants are divided into two or more cells.

The Sanitary Engineering Company, 237 Broadway, New York, is the successor to the Municipal Engineering Company, of New York (not connected in any manner with the publishers of MUNICIPAL ENGINEERING), and now controls the construction of plants of this design. That company will respond to requests for further information.

New Sewer Pipe Works.

The Stratton Fire Clay Company has recently constructed a sewer pipe factory near Empire, O., which is a model of its kind. This factory has been in operation but little more than a year, and the demand for pipe has been so great that they have recently purchased the Ohio River sewer pipe works, near by, thus enlarging their capacity to twenty-five cars a day. With other interested parties, another purchase of fire clay land in the same vicinity has recently been made and a still larger factory will be built on it. This new company will be known as the Great Northern Sewer Pipe Company. The Strattons thus control 1,000 acres of fire clay land, about 800 acres of which is underlaid with coal, which can be used in burning the clay.

Crushing Strength of Century Cement Blocks.

In an article under the above heading, in the April number of MUNICIPAL ENGINEERING, was a statement taken from a letter of the W. & J. Littlejohn Co., that the Century cement block carried a pressure of 60,000 pounds to the square inch. Inquiry of the Century Cement Machine Company, which makes the machine in which the blocks were manufactured, as to the correctness of this statement, brings from them the statement that it is their opinion that the 60,000 pounds was carried by 35 per cent. of the block, and not per square inch, though they have no information except the letter referred to. As the blocks are 8 inches high, 10 inches wide and 20 inches long, and have two hollows in them, and it is not known whether the 35 per cent. is that portion of the total horizontal plane of the block or of the concrete portion, the pressure per square inch cannot be computed exactly, but it lies between 850 and 1,500 pounds per square inch, and is probably over 1,000 pounds, which is a very satisfactory result.

Qualities of Asphalt.

Mr. F. Condit, of the Eastern office of the California Asphaltum Sales Agency, makes the following contribution to the discussion of the qualities of various kinds of asphalt, started by the recent appearance of the book referred to by him:

With many others interested in good asphalt pavements, I have read Mr. Clifford Richardson's book upon that subject, and also a recent review of the publication by Mr. S. Whinery.

Through many pages and chapters devoted to soils, drainage, foundation, base, concrete, sands, cement, binder course, etc., Mr. Whinery follows the author with cordial approval. We are finally, however, pained by a discordant note. The pleasing harmony disappears. They agree about sands as if they had played together upon the same sand heap when they were boys, but when asphalt is reached, they stand like Jap and Russ with drawn swords, in Manchuria. * * * Mr. Richardson claims Trinidad asphalt to be best to produce successful pavements, while Mr. Whinery stoutly maintains it to be unsafe and objectionable.

In reference to another asphalt, that obtained from refining the asphaltic oils of California, their pleasing accord is again in evidence. They agree that the product of Trinidad Lake, a combination of asphaltic bitumen, earth, etc., should be called asphalt, while the California bitumen should be called "residual pitch." Both admit that it sometimes produces excellent pavements, but claim that it is a by-product, often carelessly refined and frequently subjected to excessively high temperatures in process of refining.

May I point out a few facts?

(1) That every known asphalt is a product of asphaltic petroleum.

(2) That in the asphalt deposits of Trinidad and Venezuela the lighter oils have evaporated under the rays of a tropical sun, while in California the same result is obtained by refining.

(3) Both classes of products have to be refined, one to get rid of earthy matter and water, and, with the other, to separate it from oils.

(4) That carelessness in refining the California product is rare. The business success or failure of the refiners is at stake, and both Messrs. Richardson and Whinery are aware that no mined asphalt ever ran so chemically uniform as the product of the asphalt refineries of California.

(5) That asphalt is one of the most important products of California petroleum, often amounting to from 25 to 60 per cent. of the whole, and some refineries produce nothing else. To call this a by- or residual product is an absurd misuse of language.

(6) After an examination of asphalt pavements in most important American cities, we are prepared to say that we have seen few defects where this asphalt has been used, and no case where the failure was due to the material.

If excellent pavements are being laid by contractors with this material in every section of our country, in some cases without engineering assistance, what would the record have been if it could have had the advantage of such expert supervision as Messrs. Richardson and Whinery could have given?

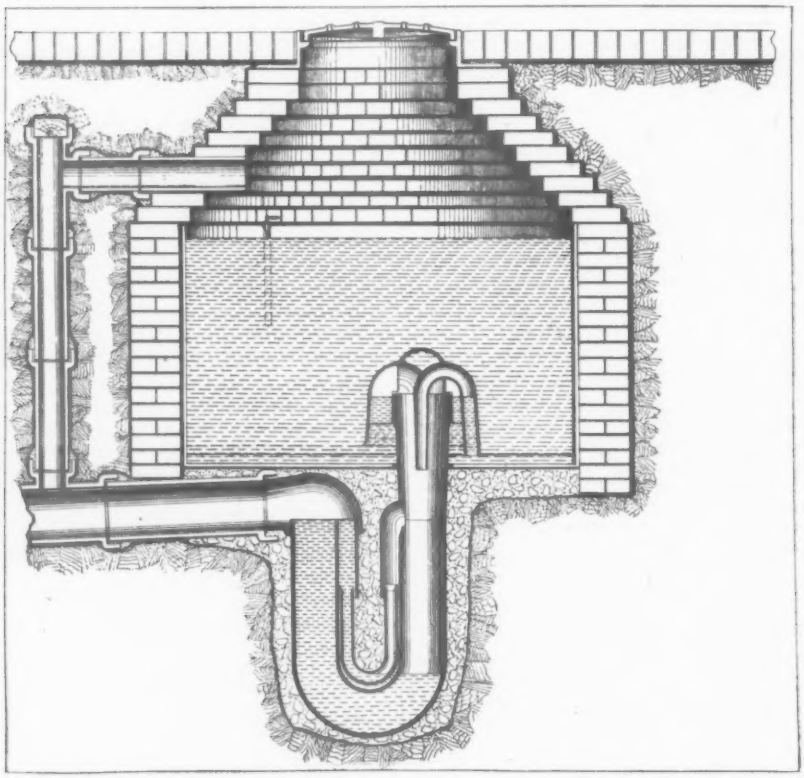
Flush Tanks for Sewers and Sewage Disposal Plants.

Engineers and contractors experience considerable difficulty in securing and installing syphon flush tanks that will effectively flush the lines of sewer to which they are attached. This is due to the ever varying conditions that the automatic syphon must meet. For instance, a long line of the sewer terminates at a point where the grade line of the sewer is so near the surface of the street that it is impossible to build a tank, of the ordinary form, large enough to efficiently flush the sewer; and frequently the depth of the sewer, as considered from the street surface to the grade line of the sewer, is not sufficient to permit the installation of a flush tank, for the reason that the depth of water required to bring the syphon into operation cannot be contained in the allowed depth of tank. The De La Hunt adjustable syphon entirely overcomes the difficulties named and permits the installation of a flush tank of suitable capacity for all depths of sewer. Where the terminals of the sewer are very shallow, efficient flushing is secured by installing the syphon in combination with a special shallow tank. For greater depths the ordinary form of tank is usually sufficient, the syphon being adjusted to the required depth of water in the tank. Adjustment is made by raising or lowering the subsidiary trap, which trap is movable, upward or downward, in sleeves made integral with either leg of the main syphon. At the time of installa-

tion the subsidiary trap is raised or lowered, as the case may be, until its depth of seal, plus 6 inches, equals the discharging depth of water desired in the tank.

The construction of these syphons tends to eliminate all acute angles around which the water flowing through the syphon must pass, and the diverging inlet permits a large inflow of water, thus insuring a full and rapid discharge. It is strongly claimed by the manufacturers that these syphons are 30 per cent. more rapid in discharge, and therefore 30 per cent. more efficient in flushing, than any other syphon made. These syphons are especially desirable for use in sewage disposal plants, septic tanks, etc., as they do not require the venting apparatus necessary with other syphons used in this line of work. The bell of the syphon is provided with an afterfill, or syphonic vent, which operates to lower the water in the tank below the mouth of the bell, opening the same to the free admission of air, and at the same time refilling the trap of the main syphon. Therefore, no vent is required at the discharge end of the syphon.

The accompanying drawings show the standard form of tank and a special form intended for shallow sewers, in which the capacity of the small round tank is increased by connecting with it two or three lengths of vitrified sewer pipe laid in concrete. These tanks are made by the De La Hunt Flush Tank Company, of Cedar Rapids, Ia., who will respond to requests for further information. They have been in use for fifteen years, and are reported to give full satisfaction, the city of Cedar Rapids now having over one hundred in operation. The company also make covers for flush tanks and manholes of special design to secure ventilation and keep street dirt out.



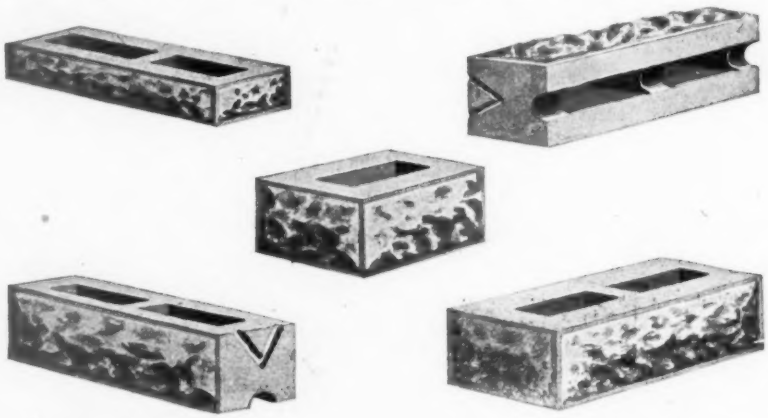
THE DE LA HUNT SIPHON.

The Waterloo Concrete Blocks and Bricks.

A casual observer could not but remark that concrete blocks are becoming more popular, as a building material, every day; that their utility is only dependent on the care with which they are constructed. Perhaps no business has its

future more dependent on the honesty of the labor in its construction. However, the object of this article is not so much to consider the subject of the honesty of employes, as it is to call the attention of our readers to the product of the Waterloo Concrete Brick and Block Machine Company. This company, which is located at Waterloo, Ia., is backed with an authorized capital of $60,000, of which $52,000 is already paid up, and is made up of young business men of that enterprising city, some of whom have spent several years in close study of the needs of the users of concrete, as is demonstrated by a careful study of their machine, a cut of which will be found in their advertisement in another part of this issue.

The main object to be attained, which



Fractional corner block. Block showing binding groove and "hand hole." Corner block. Block showing "hand hole" as horizontal air passage. Corner b ock.

WATERLOO CONCRETE BLOCKS.

fully came up to the anticipations of the inventors of this machine, was a machine that would reduce the cost, in labor, of producing a block, to the lowest possible point. How well this was done is demonstrated by the fact that with this machine two men can easily make 250 blocks per day. This could only be accomplished by the construction of a machine simple in its operation and requiring the shortest possible time in that operation. This means that this one movement unlocks the molds, drops them from the block and removes the cores, so that the block is ready to be immediately removed from the machine.

Another object was the making of a block that would be damp-proof and frost-proof. This was attained by the construction of a block that has double air spaces, one of which is vertical, as in the ordinary hollow block, while the other is horizontal, making a continuous air space in a wall made of these blocks. The horizontal air passage also provides a "handhole," which greatly facilitates the handling of the blocks after they are cured. Every mason recognizes this point at once, as he saves his fingers, saves time in picking up a block and does not chip the edge or break a corner, as is frequently done in handling the ordinary block. The accompanying cut shows the "handhole" and air space.

The brick attachment was another desired object. This machine makes eighteen brick at one time as easily as a block can be made. Other features of the machine are: The absence of all gears and chain; the block remaining stationary during the operation or the machine; the variety of blocks that can be made from the machine, including circle, octagon blocks and porch pier, or chimney blocks. This machine is easily and quickly adjusted for making the various styles and sizes. The binding frame about the molds positively prevents the machine from being tamped open, insuring the block to be perfectly true. This machine is guaranteed for one year.

O. H. Sweeney is secretary. Write him for prices and catalogue "A."

How to Introduce Hollow Concrete Blocks.

The Van Horne-Wallis Concrete Stone Company has recently begun in Indianapolis, Ind., the manufacture and sale of Miracle double air space concrete blocks, and has issued a booklet giving the points

of value of these blocks and the principles upon which their methods of doing business are founded.

It is encouraging to find a company who propose first to make good blocks from the best materials, selected with special reference to the work they are to do; second, to meet all the demands of the architects in form, color, face and finish, and to announce that "in order that no extra time or expense be laid upon the architect in preparing his plans, we retain a skilled draughtsman, who works out the stone details for each particular structure. By so doing every block fits its particular niche, and the result is as happy as with highest grade cut stone."

Only third is the question of cost considered, and comparisons are made with cut stone and pressed brick for fine work, with rubble stone and common brick for foundations and ordinary work.

The book also contains information about the strength of blocks, number required, and the good qualities of buildings constructed with them.

Bitulithic Contracts in St. Louis.

The large amount of Warren's bitulithic pavement laid in St. Louis prior to and during the Exposition proved so satisfactory that the city has continued to let contracts for that material at a rapid rate. The following is a list of the contracts entered into by the Granite Bituminous Paving Co., which lays Warren's bitulithic pavement in St. Louis, since the close of the last season:

Bellefontaine av., from 13th st. to Broadway, 120 squares.
Lee av., from Red Bud to Newstead, 594 squares.
Florissant av., from Warne to Harris, 793 squares.
Delmar Blvd., from Clara to Hamilton, 980 squares.
Clemens av., from Clara to Goodfellow, 548 squares.
McPherson av., from Euclid to Kingshighway, 196 squares.
Chestnut st., from 4th to Broadway, 83 squares.
Ashland av., from Clay to Newstead, 1,129 squares.
Grant av., from Warne to Harris, 414 squares.
Eleventh st., from intersection of 13th to Bellefontaine, 1,399 squares.
Union Blvd., from Delmar to Forest Park, 1,331 squares.
Florissant av., from Harris to Carrie, 972 squares.
Thirteenth st., from Park to Chouteau, 407 squares.
Total, 8,966 squares.

A square is equal to 100 sq. ft., and the total amount of pavement above referred to is 99,622 sq. yds.

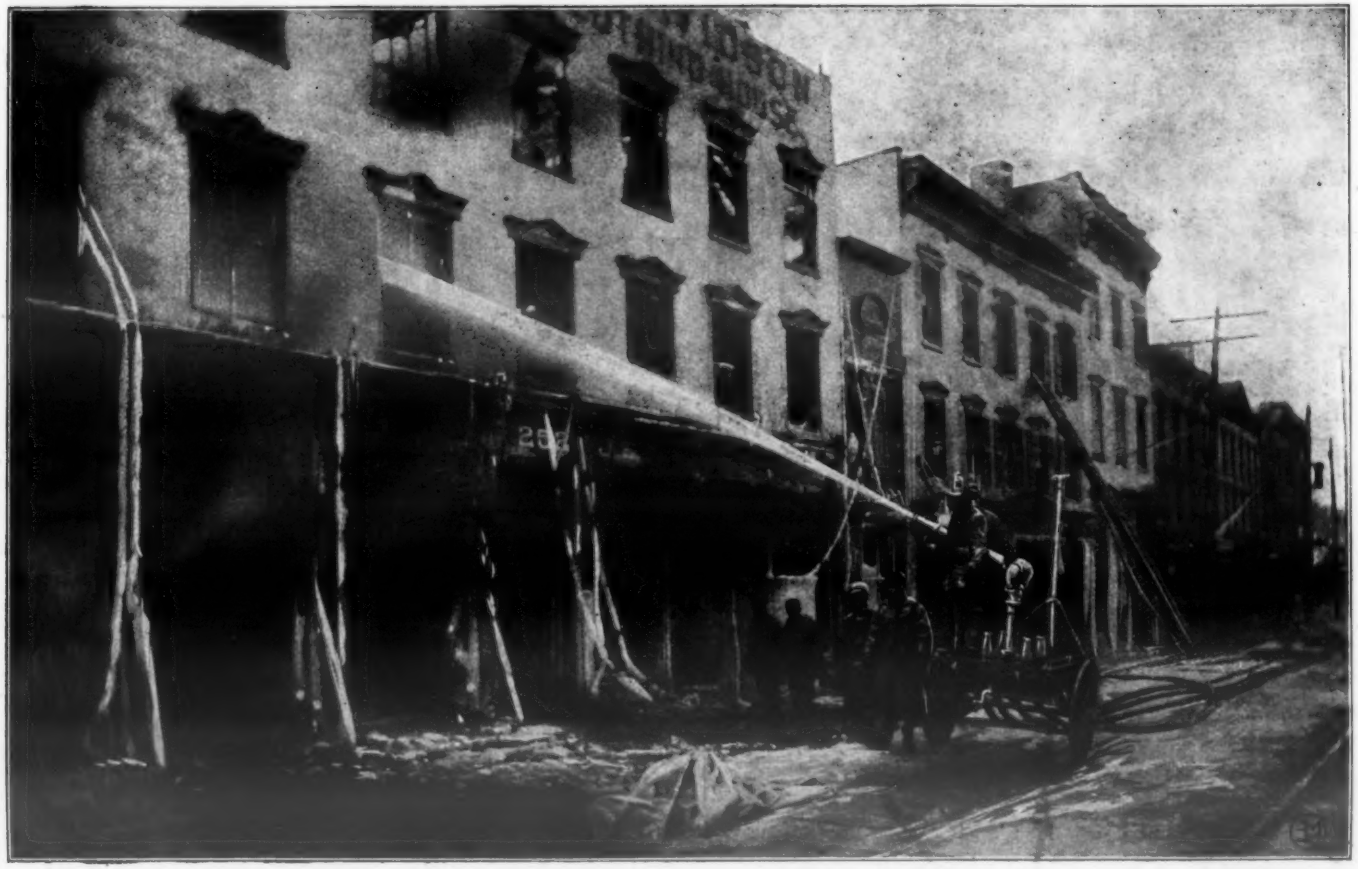
Three of these contracts, aggregating about 15,000 square yards, were let June 21, 1905.

A committee of property owners from Paducah, Ky., recently visited St. Louis, to report upon the pavements there. While there they saw the Chestnut street pavement, which has been in trouble on account of haste in laying in too cold weather to prepare for the opening of the Exposition, and have had a similar experience with a small amount of the pavement laid in cold weather in their own city, the members of the committee agree with Mr. Rudy, one of their number, who, in an interview with a reporter of the *Paducah Sun*, says:

"After my investigations, and the investigations of the gentlemen in our party, I am satisfied that bitulithic is the material for our streets. I find that it has a better base, better foundation, has more resiliency, and is easier on horse and pedestrian. In our investigations we stopped drivers on wagons on the streets, stopped and talked with automobilists, and interviewed the street department as well as private citizens, and it is my candid opinion that if the work is done in proper season, and is done like the work was done in St. Louis, that bitulithic is the material we should have on Jefferson and Kentucky avenues. In St. Louis they are laying thirty-five miles of new streets, and the fact that the bitulithic was used as much as asphalt evidenced to me the people, who have investigated all kinds of street paving and had experience with all kinds, rather favor bitulithic—all things being equal."

Some Remarkable Fire Fighting and Fire Protection Apparatus.

The well-known Glazier Nozzle and Manufacturing Co. of Indianapolis, Ind., have recently added to their list of fire fighting apparatus a device for producing a water curtain on the outside of a building to protect it from fires in neighboring structures. It is in the form of a rotary head, which, with a nominal pressure of water, about five pounds, will throw a sprayed stream of water. Several of these heads are mounted near the line of the eaves of a building so that the streams from them will be discharged parallel to the plane of the wall. A water curtain is thus formed, which is about two feet thick, and, on account of the large size of the openings in the nozzles of the revolving heads, is always in action and forms a complete curtain. This method of forming the curtain also has the advantage of protecting the roof, if it projects above the line on which the rotary heads are located, for, as the heads rotate they throw water above the line of the eaves and thus wet down the roof and interpose a water curtain between the fire and the roof similar to that which protects the wall of the building and the openings in it. The rotary heads are of brass and are mounted with bronze ball bearings, so that there is nothing about them to rust and they are always ready for action. Insurance companies have accepted the device as an acceptable fire



THE GLAZIER NOZZLE MOUNTED ON A WAGON.

protection, and the Western Union of Fire Underwriters takes off buildings equipped with it the insurance charge for exposures to fires in neighboring buildings. The water curtain made by these rotary heads is the only accepted water curtain for theater use in Indiana. Although the device is entirely new and has not yet been fully introduced to the public, many buildings in Indianapolis, Chicago and other cities, piers at Hoboken, N. J., and elsewhere have already been equipped.

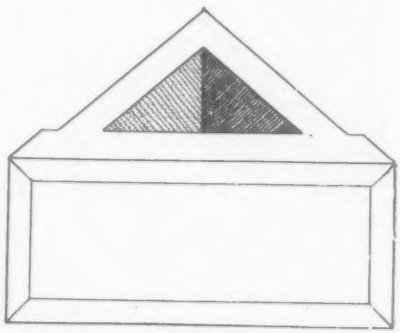
New applications of the famous Glazier nozzle for fighting fires are made from time to time, the latest being its attachment to a ladder in such manner as to make the equivalent of a water tower. The economy of such an arrangement is evident at once to the practical fireman. The ladder, nozzle and hose would cost perhaps $150, while a water tower of equal capacity would cost several thousand dollars, and the cost of annual repairs is in about the same proportion. The principle of the Glazier nozzle is well known, although not generally understood, and is such that the nozzle when attached to the rounds of a ladder can be raised to any elevation and set at any desired elevation for playing upon a building without danger of overturning the ladder by the back pressure. The angle of the nozzle is fixed at will by a rope and the opposite pull of a spring in its mounting on the ladder. It has been operated at pressures of 150 to 190 pounds per square inch without overturning the ladder on which it is mounted. It takes the eye of fire chiefs at once and quite a nounced as ready for the market.

The standard Glazier nozzle continues to have a large sale. The new Washington fireboat has a Glazier nozzle, throwing a 5 1-2-inch fire stream. It is set on a 10-inch upriser from the pump and goes into service this summer. Philadelphia has four for 3-inch streams, operating under 350 pounds pressure in its new high pressure fire service. One man operates a nozzle without difficulty. At the recent Indianapolis fire Glazier nozzles were set to play on the ruins and left without attendance while the firemen were otherwise engaged. Several railroad companies, such as the B. & O., Erie, Pennsylvania, etc., are equipped with nozzles for their fire protection systems in docks, depots, storehouses and boats. Twenty-five of the Standard Oil Company's boats have them. Keith's theater syndicate is equipping its houses with them, the great meat packing establishments are well supplied and there are many other like private users of the apparatus in addition to the many municipal fire departments equipped with them. The accompanying illustration shows the nozzle belonging to the fire department of Schenectady, N. Y., mounted on a wagon, making it the best and most convenient piece of apparatus for fighting a fire from the ground as well as from the ladder tower above described.

Another good use for the Glazier nozzle, where there is a water supply under good pressure, is for stripping the earth from a quarry. The ease of handling the nozzle and the possibility of setting it to play on a given spot without attendance make this a most economical method of moving earth where water is abundant.

A Well-Ventilated Wall.

The Mandt Cement Block Co. has put on the market a block which, they say, does away entirely with the objection of contractors that frost penetrates the wall,



THE MANDT CONCRETE BLOCK.

and makes it necessary to lath and plaster. The Mandt block is shaped in such a manner that when laid up in the wall, an air space is formed between the blocks, which runs continuously from the bottom to the top of the wall, as well as horizontally around the entire wall. Then to insure more perfect ventilation the blocks themselves are hollow, causing a double air space. This double air space makes a wall that is entirely impervious to heat and cold, and for that reason the plaster can be put directly on the inside wall, saving the expense of furring and lathing.

The exterior wall can be made to represent cut stone in its various forms as easily as a plain surface.

These blocks, simply by spreading them a little further apart when laying, will make a wall from 11 to 16 inches wide.

If waterproofing is desired it can be done very cheaply by making the front block richer than the back, and in the same way can the cost of coloring be saved, when a colored effect is desired.

The blocks are light to handle, making

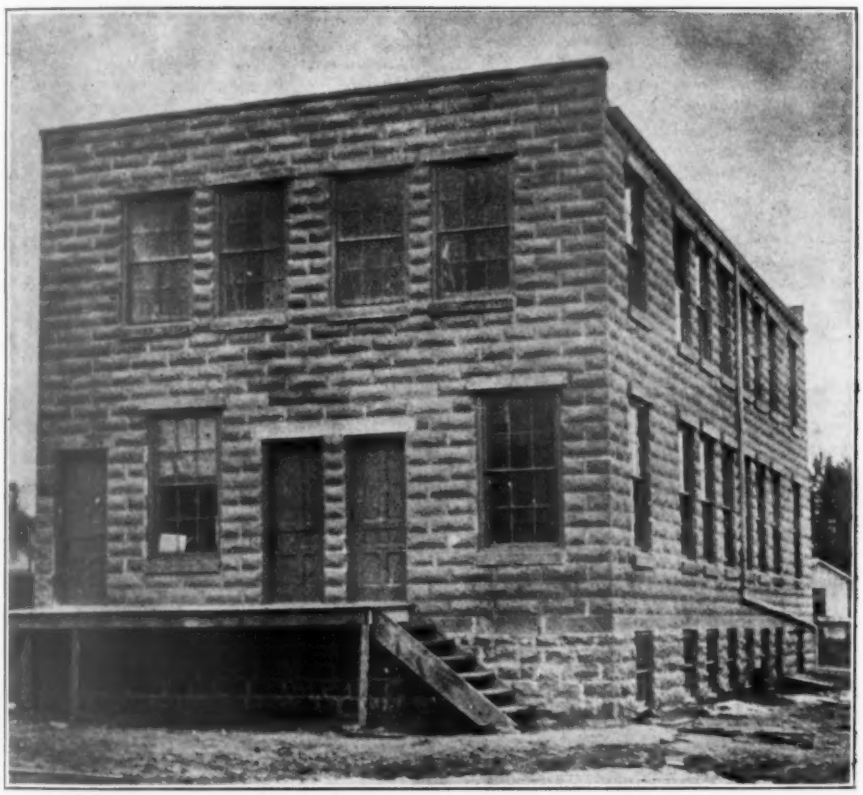
it easier for the masons, who highly recommend them for this.

The molds in which the blocks are made are very simple, the back consisting of two pieces hinged together at the back and shaped in such a maner that at the front they fit into a groove on the edges on the front plate, to which they are hooked when set up, the hooks being made of steel and having a little handle attached, so that they are easy to hook and unhook. The fronts are grooved on the edges at each end, into which the back fits, making it impossible to pull loose, consequently all blocks have sharp edges and look very neat. The core, which is cast, tapers at the bottom, making it easy to withdraw. It has a concealed handle on the top.

The molds are adapted to make all kinds of blocks as well as any size, even down to fractions of inches.

With this outfit the expense of iron pallets is saved, which amounts to a large sum when any amount of blocks are to be made.

The accompanying photograph is of a shoe factory built at Stoughton, Wis., of the Mandt cement building blocks. This building was plastered directly on the inside wall and has stood the test very satisfactorily. The small cut shows a panel faced block and gives a good idea of the form of the block.



SHOE FACTORY, STOUGHTON, WIS.

Built of Mandt Concrete Blocks.

Cement Sewer Pipe.

This magazine has many inquiries for practicable molds for making cement sewer pipe, and requests for information about the relative value of cement as a material for making sewer pipe. The advantages of this material for this purpose and the points which must be guarded have been discussed quite frequently in MUNICIPAL ENGINEERING and the general conclusions are stated in the number for August, 1904, page 113, in the Question Department, and are very favorable to

the use of well constructed cement sewer pipe especially on account of the smoothness of surface and the probability of less roughness at the joints if the pipes are well laid.

The inquiries regarding methods of making sewer pipe may be answered by referring to the Johnson Cement Pipe Molds, which were patented October 11, 1904, patent No. 771,911. With these molds a contractor can make his own sewer pipes of any size and of various shapes. If properly made, cement pipes compare favorably with other kinds of sewer pipe in strength and durability, and there are now several methods of making them impervious to water, so that the concrete or sewer contractor who has a set of these molds in his possession can control his own sewer making from start to finish. The Johnson cement pipe molds are sold by the Brookings Cement Block and Sidewalk Co. of Brookings, S. D. They report that the molds have been improved since they were first invented and they can now be operated at twice the speed of those first made.

Trade Publications.

The Buffalo Forge Company, of Buffalo, N. Y., has issued the second of its "Engineering Lore Series," which contains a report by R. C. Carpenter, of Cornell University, on a test of one of its compound engines.

Albert Moyer, of the Vulcanite Portland Cement Company, Flatiron Building, New York, is the compiler of a pamphlet on "Concrete Buildings and Their Architectural Possibilities," which describes and handsomely illustrates the methods of constructing and ornamenting the recreation buildings of the Chicago South Park Commission.

The Miracle Pressed Stone Company, Minenapolis, Minn., issues a catalogue entitled, "Tells How to Make More Money," by adding to a cement block plant the Miracle sewer pipe molds for making any sizes from 10 to 24 inches in diameter, with or without bells. The pamphlet is fully illustrated. The company also sells the Miracle machine for making staggered air space cement building blocks and machine for making cement sidewalk blocks, and deals in cement tools and appliances for cement construction.

The Rutty metal wall plug and its uses are described and illustrated in a catalogue issued by J. B. Prescott & Son, Webster, Mass.

"Progress in Sewage Treatment" is a pamphlet descriptive of methods of sewage treatment, issued in occasional numbers by Merritt & Co., of Philadelphia, makers of sewage treatment apparatus.

The National Building Block Machinery Company, Milwaukee, Wis., issue a handsomely illustrated catalogue of the parts of the two-piece block machine they manufacture.

The Chickamauga Cement Company, Chattanooga, Tenn., issue a circular descriptive of their "Hydrated Portland Lime."

Mr. C. W. Hunt has issued Catalogue 054, containing a full description of the methods of applying manila rope to the work of transmission of power and hoisting.

The Hunkins-Willis Lime and Cement Company, St. Louis, Mo., issue a catalogue of their building material specialties, giving methods of applying and using Keene's cement, wall and floor enamels, paints, damp-resisting compounds, wood and stone preservatives, and many special building appliances, such as wall ties, nailing plugs, steel lath, etc.

Trade Notes.

ASPHALT.

Pittsburg, Pa.—The contract for a municipal asphalt paving repair plant was awarded, June 10, to the Kelly Road Roller Co., of Springfield, Ohio, for $9,631.

Detroit, Mich.—Council adopted a resolution, June 6, authorizing the commissioner of public works to enter into a contract with Hetherington & Berner, of Indianapolis, for the purchase of a portable asphalt plant.

Indianapolis, Ind.—The Capital Asphalt Co. has been incorporated, to build pavements, construct streets and conduct a general contracting business, by W. K. Cooper, H. C. Churchman and J. N. Morgan.

Kansas City, Mo.—The asphalt plant of the Parker-Washington Asphalt Paving Co. was destroyed by fire June 13, entailing a loss of $30,000.

New Orleans, La.—The Warren Asphalt Paving Co., Cambridge, Mass., was the only bidder, June 19, for constructing an asphalt repair plant for this city. The company's bid is $11,800.

BRICK.

Jonesboro, Ark.—The Jonesboro Sand, Cement & Brick Co. has been incorporated, with officers as follows: President, M. A. Dunion; vice-pres't, Lewis Sachs; sec'y., J. H. Kitchens.

Jersey City, N. J.—The New York Granite Brick Co. has been incorporated here by William B. Parsons, St. John Clark, John A. Wilbur, F. A. Crandall and Donald Ross.

Terre Haute, Ind.—Special.—Will P. Blair, se'y., announces that on June 1, the Terre Haute Brick and Pipe Co. transferred all its business and property to the Terre Haute Vitrified Brick Co., and that the new company will assume all the debts and obligations of the former organization and collect all money due. The active officers of the Terre Haute Vitrified Brick Co. are the same as those of the Terre Haute Brick and Pipe Co.

Connellsville, Pa. — Special. — Messrs. Frank Peifly, W. G. Hunter, L. P. Wentzel and George P. Alms have made application for the incorporation of the Peifly

Builders' Supply Company. The object of the company is the mining and quarrying of stone and rock, clay and shale, and the manufacturing of same into brick, sand, lime, cement, ballast and crushed stone, etc.

Conneaut, Ohio—The United States Brick Co. has purchased the Harper-Norton Shale Brick Company, and will improve the plant and resume the manufacture of brick on an extensive scale.

Detroit, Mich.—The Scott Manufacturing Co., of St. Louis, Mo., submitted the lowest bid for the construction of a municipal brick plant in this city. Bids for a municipal plant were advertised three times, and it was at the request of the Scott Mfg. Co. that the bids were readvertised the last time, after Commissioner Maybury has recommended the bid of the C. W. Raymond Co., of Dayton, Ohio, for acceptance. The bids were as follows: Scott Mfg. Co., $39,897 for plant of 20,000 daily capacity, and $48,893 for 30,000; Raymond Bros., $43,456 for 20,000 brick; Hadley Bros., of Canton, $45,000 and $54,000; Herman Reich, $43,500 and $45,850. It is believed a plant of 20,000 brick capacity will be decided upon.

Indianapolis, Ind.—The Indianapolis Composite Brick Co. has been incorporated to manufacture and deal in all kinds of brick, tile, ornamental stone, etc., and may buy or lease plants, franchises or property. The board of directors is Louis Morgan, Conrad Bender, Ballard V. Perry, Lawrence Elkus and C. S. Griswold.

Alliance, Ohio—At a meeting of the Business Men's Association, June 1, Ross Rue reported that the test of Alliance clays during the last month at the Waynesburg brick plant had resulted in establishing beyond question its superiority for making tile, hollow block, building and paving brick, etc. Mr. Rue suggested the organization of a company for establishing a paving brick and tile plant, and offered to head such a movement with a stock subscription of $1,000.

Newark, N. J.—The Jerest Paving Corporation has been incorporated to manufacture brick, tile, earthenware, terra cotta and ceramic wares of all kinds. William G. Coates and John C. Lyon, of Newark, and Thomas Conyngton, of Montclair, are interested.

Moundsville, W. Va.—The Malvern Fire Clay Paving Brick Co. has been incorporated by Allan P. Creighton, J. F. Williams, T. E. Cramhist, of Wilkes-Barre, Pa., and Dr. W. H. Woodruff and A. B. Creighton, of Moundsville, W. Va.

Massillon, Ohio—A process has been discovered by S. W. Griffith, of this city, whereby silica sand brick can be hardened and made entirely fireproof. Mr. Griffith has also discovered a large section of silica sand stone at Warwick and has leased nearly 250 acres of land. With the aid of E. A. Westerfield, representing the Anderson Foundry & Machine Works, of Anderson, Ind., and the American Sand Lime Brick Co., of Chicago, he will begin at once the organization of a stock company for the manufacture of brick.

CEMENT.

New York City.—The Palmer Lime & Cement Co. has been incorporated to manufacture cement and building material and deal in sand, stone, etc., by Lowell M. Palmer and Lowell M. Palmer, Jr., of Brooklyn; Lucius M. Koons, Plainfield, N. J.; Henry M. Brigham and Egbert V. Nelson, of New York City.

Atlantic City, N. J.—The Association of American Portland Cement Manufacturers decided, at its convention, June 13, that in view of the scarcity of stock, it would be advisable to raise the price about 5 per cent.

Iowa City, Ia.—According to the report of State Geologist Frank A. Wilder, this state is rich in deposits of cement.

Santa Cruz, Cal.—The Standard Portland Cement Co. will build a new plant here.

Hoboken, N. J.—The Standard Cement Co. has been organized to deal in cement, by Harry B. Ayers, Union Hill, N. J.; Benjamin Banner, New York City; Philip Ostermayer, Jersey City Heights.

The Cement Machinery Company, Jackson, Mich., is reported to have made arrangements with the Underwriters' Laboratory, in Chicago, for a test of the fire resisting qualities of hollow concrete blocks, the Normandin blocks to be furnished by this company for the test. At Marion, Kans., a recently reported test showed that concrete blocks stood a fire test with temperature of 1,000 degrees, which building stone tested at the same time would not stand.

CONCRETE BLOCKS.

Canton, Ohio—The Bonnot Co. has sold to the Hydraulic Stone & Building Block Co., of Bucyrus, Ohio, a new cement mixer.

Decatur, Ind.—The Cement Block & Shingle Works, of this city, are preparing to build a new plant at DeWitt, Ark.

Pierre, S. D.—The Pierre Cement Brick & Oil Co. has been incorporated by J. L. Lockhart, H. D. Jennings, S. G. Trine, Ellen Jennings and John B. Lockhart, of this city, who own deposits of cement shale along the river.

Logan, Utah—The Western Cement Block Building Co. has been incorporated by Henry T. Cornwall, president; vice-president, Robert Murdock; secretary and treasurer, G. F. Thatcher.

Walkerville, Ont.—A concrete building block plant will be established here by George P. Saffen and George H. Hindelary, of Chelsea, Mich.

Toledo, Ia.—Concrete shingles are being manufactured by Fred Seush, who invented the machinery he uses.

Escanaba, Mich.—Arnsen Bros. have added machinery for the production of cement building blocks.

Wentworth, S. D.—The Concrete Construction Co. has erected a building of concrete blocks in which to manufacture concrete building blocks.

Wallace, Idaho—The Wallace Concrete Stone Co. has been incorporated and will make blocks from the tailings of the concentrators of that district.

Jackson, Ohio—Frank Gray, of the Jackson Foundry & Machine Co. and the Concrete Block & Paving Co., has installed two Normandin machines, manufactured by the Concrete Machinery Co., of Jackson, Mich.

Grand Forks, N. D.—S. Miller and John Vallalley have formed a partnership for the sale of the Winner block machine in the northern half of the state.

Oakes, N. D.—A company has been formed by H. S. Nichols, E. Sanderson, George Stanley and others, and will engage in the production of concrete blocks.

Eau Claire, Wis.—The Northwestern Steel & Iron Works has been formed to manufacture concrete building block machines under the patents of P. J. Holm.

Casey, Ia.—William F. and F. R. Valentine will manufacture concrete blocks, using the Miracle machine.

Minneapolis, Minn.—The Thayer Cement Block Machine Co. has been incorporated by George A. Hughes, Lewis V. Thayer and Alexander Hughes.

Sacred Heart, Minn.—The Sacred Heart Miracle Building Block Co. has been formed here by Carl Anderson and John Turner, and will manufacture Miracle blocks.

Perry, Ia.—J. H. Guinn has patented a machine for the manufacture of cement tile, a feature of which is a removable core, which adds to the speed of the outfit.

Cincinnati, Ohio—The American Concrete Construction Co. filed a deed of assignment June 10, to Charles H. Urban. The company's assets are placed at $2,500 and the liabilities at $12,000.

Ivanhoe, Minn.—Olson Bros. have purchased a Brookings concrete block machine.

Perry, Ia.—An improved block machine has been devised by Harrison Murray, which will make blocks with three or four different colored faces and two sets of air cells, one horizontal and one perpendicular.

Minneapolis, Minn.—The Minneapolis Paving & Cement Brick Mfg. Co. has established an office at 1019 N. Y. Life Bldg. The company has a plant at Bryn Mawr about ready to manufacture brick.

Plainfield, N. J.—The Plainfield Cement Co. has installed a full equipment of machinery, manufactured by the Hayden Automatic Block Machine Co., of Columbus, Ohio.

PURCHASE OF MACHINERY.

Tacoma, Wash.—Special.—L. C. Hall, 220 Washington Block, desires catalogues of machinery necessary for the construction of asphalt or tar and gravel sidewalks.

Lansing, Mich.—Special.—C. E. Crownover, 802 Shiawassee ave. W., desires block purposes.
poses.

Indianapolis, Ind.—Special.—Thos. Runyan, 42 When Bldg., desires catalogues and information regarding concrete block machines and plants.

New York City—Special.—The Bell Engineering & Con. Co., 220 Broadway, advises us that they are interested as possible purchasers in machinery and tools for reinforced concrete and railroad work.

Lyndonville, N. Y.—Special.—Thos. H. Hie, contractor in general mason work, stone, brick, plastering, sidewalks and concrete walls for cellars, and dealer in cement plaster and lime, is in the market for a block machine.

PURCHASE OF MATERIALS.

Port Arthur, Ont.—Special.—The Algoma Builders' Supplies Co., Ltd., desires to correspond with cement companies.

Decatur, Ill.—Special.—H. F. Robbins, cy. compt., desires the addresses of firms who have crushed quartz or filter sand for sale.

LIGHT, HEAT AND POWER.

Peoria, Ill.—The Peoria Automatic Gas Machine Co. has been formed for the manufacture of heating and lighting apparatus, by John A. Basswell, Richard G. Hebden and Frank S. Hebden.

Watertown, N. Y.—The W. E. Kenney Co. has been incorporated to manufacture and install electrical apparatus, by Addison F. Lansing, Walter E. Kenney and Fred M. Boyer.

Crawfordsville, Ind.—The Johnson Acetylene Gas Co. has been incorporated by John Johnson, George Dillman and William Banks.

Baltimore, Md.—The Electric Mfg. Co. has been incorporated to manufacture electrical appliances and machines, by James L. Murrill, Edward V. Quigley, Charles H. Miles, Wililam G. Thum and William E. Hoffman.

Newly Incorporated Companies: Iowa Falls, Ia.—Iowa Gas Co.—W. H. Woods and others. St. Charles Mo.—St. Charles Lighting Co.—Joseph McCollum, Lloyd Shepard, Charles F. Johnson and Robert H. Lawlor, of East St. Louis, Ill., and Edward Gut, S. O. Fulkerson and C. O. Collier.

MISCELLANEOUS.

Uhrichsville, Ohio—The Robinson-Graves Sewer Pipe Co. has been incorporated by Andrew Robinson, M. J. Robinson, C. L. Graves, G. D. Graves, W. H. Bergin and Corrinne M. Bergin.

Chicago, Ill.—The Economic Engineering & Construction Co. has been organized to do a general contracting business, by W. A. Sharp, D. A. Raymond and George E. Waldo.

Evansville, Ind.—The Tri-State Stone Co. has been incorporated to manufacture stone into all kinds of products for any and all sorts of building and road purposes, by F. J. Scholz, John Friday, Bennett Whitehead and others.

Tyrone, Pa.—The West Brook Sand Co. has been incorporated to develop extensive silica banks near here, by Joseph G. Lee, B. C. Simms, H. N. Harker, Geo. S. Goodwin and H. A. McNicol, of this city.

New York City—The Ingersoll-Sergeant Drill Co. and the Rand Drill Co. have been consolidated into a new company called the Ingersoll-Rand Company. The factories of the two companies are located at Phillipsburg, N. J., Easton, Pa., Tarrytown, N. Y., Ossining, N. Y., Painted Post, N. Y., Thirty-fourth street, New York City, and Sherbrooke, Quebec. All the plants will be operated. The officers of the new company are: President, W. L. Saunders; first vice-president, George Doubleday; vice-presidents, Jasper R. Rand, John A. McCall, J. P. Grace, George R. Elder; treasurer, W. R. Grace; secretary, F. A. Brainerd. The main offices of the company will be located, for the present, at 26 Cortlandt street, New York City.

Rochester, N. Y.—The Goodman Street Stone Co. has been organized here, to deal in stone for street paving, by F. X. Foery, Conrad Kastner and F. C. Lauer.

Patents of Interest to Municipalities and Contractors.

734,543. July 28, 1903. Push Wagon for Street Cleaning or Other Purposes. C. E. Hadley, Chicopee, Mass. Can mounted on two wheels, with small grinding wheel and dumping can supporting arms.

735,126. Aug. 4, 1903. Wheeled Dirt Receptacle. R. C. Menzies, Glens Falls, N. Y. Cart supporting street scraper, which tilts and rises to discharge into bag supported on frame.

736,135. Aug. 11, 1903. Street Washer. T. M. Murphy, St. Louis, Mo. Water tank, discharging under air pressure.

736,312. Aug. 11, 1903. Road Scraper. R. L. Templeman, Tackett Mills, Va.

737,224. Aug. 25, 1903. Grading and Ditching Machine. T. J. Gray, Chicago, Ill.

737,611 and 737,612. Sept. 1, 1903. Road Grader. James T. Hall, Chicago, Ill., and W. H. Hitchcock, Holland Patent, N. Y.

739,249. Sept. 15, 1903. Screen for Catch Basins or the Like. W. H. Woods, Boston, Mass.

739,383. Sept. 22, 1903. Road Scraper. Morton G. Bunnell, Chicago, Ill.

739,686. Sept. 22, 1903. Culvert. Eli C. Krupp, Lansdale, Pa.

739,746. Sept. 22, 1903. Deep-Well Propeller Pump. James M. Tillotson, Kinder, La.

740,063. Sept. 29, 1903. Street Sweeper. Horace Thompson, Concord, N. H.

740,218. Sept. 29, 1903. Street-Sweeping Machine. Robert S. Beatty, Trenton, N. J.

740,430. Oct. 6, 1903. Road Machine. Wm. A. Hensner, Carl H. Dudley and David E. Graves, Oberlin, O.

740,999. Oct. 6, 1903. Air Lift Pump. John P. Couse, Glendale, Cal.

742,224, 742,225, 742,226, 742,227, 742,228. Oct. 27, 1903. Process of Treating Garbage. E. S. Peck, Newburg, O.

742,657. Oct. 27, 1903. Street-Cleaning Machine. Samuel Hosfeld, Philadelphia, Pa.

742,839. Nov. 3, 1903. Brush for Street Sweepers. John T. Collins, Hartford, Conn.

743,020. Nov. 3, 1903. Apparatus for Heating Asphalt Surfaces. J. W. Nesmith, Denver, Col.

743,021. Nov. 3, 1903. Method of Heating Asphalt Pavements. J. W. Nesmith and F. O. Blake, Denver, Col.

743,300. Nov. 3, 1903. Trench-Digging Machine. J. H. W. Libbe, Toledo, O.

743,805. Nov. 10, 1903. Cable Holder for Manholes. H. C. Baker, Jr., New York.

743,834. Nov. 10, 1903. Portable Dry Closet. Joseph Danner, Scranton, Pa.

744,361. Nov. 17, 1903. Metal Sheet Piling. Frank N. Kneas, Chicago, Ill.

744,847. Nov. 24, 1903. Metal Sheet Piling. H. Wittekind, Chicago, Ill.

744,871. Nov. 24, 1903. Furnace for Heating Asphalt, etc. A. Montupet, Paris, France.

745,060. Nov. 24, 1903. Means for Protecting Water Pipes against Bursting by Freezing. N. M. Hopkins, Washington, D. C.

745,322. Dec. 1, 1903. Garbage Box. T. E. Burrough, Trenton, N. J.

745,824. Dec. 1, 1903. Apparatus for Expelling Water from Cellars. W. M. Griffiths, Philadelphia, Pa.

746,029. Dec. 8, 1903. Street Sweeper. Daniel B. Cliffe and William R. Cliffe, Marion, O.

746,229. Dec. 8, 1903. Street Sweeper. A. S. Young, Galesburg, Ill.

747,488. Dec. 22, 1903. Garbage Destructor. Thos. Rooke, Newtown, and John Thrush, Dulwich Hill, N. S. W., Australia.

747,652. Dec. 22, 1903. Interchangeable Asphalt, Concrete and Mastic Mixer. G. A. Schillinger, Chicago, Ill.

748,247 and 748,248. Dec. 29, 1903. Method of Laying Asphalt or Bituminous Roadways. Wm. Wilson, Geneva, N. Y.

749,269. Jan. 12, 1904. Garbage Crematory. L. F. Decarie, Montreal, Can.

749,391 and 749,392. Jan. 12, 1904. Bond and Elbow for Conduits for Electric Wires. Geo. A. Lutz, New York.

749,617. Jan. 12, 1904. Road-Making Machine. E. L. Lathrop, Ft. Wayne, Ind.

749,747 and 749,748. Jan. 19, 1904. Grading and Ditching Machine. B. O. Rhodes, Barberton, O.

750,457. Jan. 26, 1904. Crematory. F. E. Haycock and Jos. McDermott, Minneapolis, Minn.

750,752. Jan. 26, 1904. Means for Controlling Flowing Streams. E. S. Cole, Chicago, Ill.

750,934. Feb. 2, 1904. Trenching Machine. H. J. Bentson, Chicago, Ill.

751,612. Feb. 9, 1904. Sprinkler. W. H. Case, Springfield, Mass.

751,704. Feb. 9, 1904. Process of Producing Paved Tracks on Macadamized Roads or the Like. R. Weber, Burgdorf, Germany.

751,886. Feb. 9, 1904. Apparatus for Sterilizing Water. H. J. Wessels, Paris, France.

752,152. Feb. 16, 1904. Sweeping Machine. C. A. Green, Katrineholm, and H. E. Larsson, Stockholm, Sweden.

752,196. Feb. 16, 1904. Apparatus for Cleaning Sand Filter Beds. Hiram W. Blaisdell, Los Angeles, Cal.

752,709. Feb. 23, 1904. Machine for Excavating, Raising, Screening and Filling Gravel Ballast, etc. Hilary Quertier, Dunedin, New Zealand.

752,911. Feb. 23, 1904. System of Snow Disposal. J. C. Marriott, New York.

753,052. Feb. 23, 1904. Timber-Treating Process. P. F. Dundon, San Francisco, Cal.

753,231. March 1, 1904. Machine for Making and Repairing Roads. Arthur Cameron, Chicago, Ill.

755,157. March 22, 1904. Device for Cutting Asphalt. T. F. Moran, Philadelphia, Pa.

755,254. March 22, 1904. Ventilating Pipe for Sewer Systems. Frank Struhs, Grand Rapids, Mich.

755,357. March 22, 1904. Composition for Laying Dust. R. A. Chesebrough, New York.

755,596. March 22, 1904. Sweeping Machine. E. L. Keyes, Hopedale, Ill.

755,645. March 29, 1904. Machine for Cutting Trenches through Asphaltic Pavements. Granville Fernald, Washington, D. C.

755,662. March 29, 1904. Garbage Crematory. E. E. Hill, Chicago, Ill.

755,955 and 755,956. March 29, 1904. Methods of Constructing Foundations, Tunnels, Shafts or Other Excavations. Charles Sooysmith, New York.

756,323. April 5, 1904. Road Grader. H. L. Braly, Clarendon, Tex.

756,333. April 5, 1904. Paving Block. F. E. Cooper, Waterloo, England.

757,459. April 19, 1904. Trench Digger. John Helm, St. Louis, Mo.

758,071. April 26, 1904. Sidewalk Cleaner. T. S. Hiles, Chicago, Ill.

758,343. April 26, 1904. Garbage Cart. R. D. Wirt, Philadelphia, Pa.

758,354. April 26, 1904. Street Waste-Paper Box. G. C. J. Engelland, Blue Island, Ill.

760,051. May 17, 1904. Process of Preparing Compositions for and of Heating and Laying Bituminous Pavements. J. H. Amies, Germantown, Pa.

760,205. May 17, 1904. Sewer-Digging Machine. J. J. Hickey, St. Louis, Mo.

760,434. May 24, 1904. Receptacle for Ashes or Garbage. Mary A. Donohue, New York, N. Y.

760,543. May 24, 1904. Sewage-Purifying Apparatus. Frank Martin, Camden, Me.

760,965. May 24, 1904. Flush Tank. John F. Cunningham, Springfield, Mo.

761,316. May 31, 1904. Double-Trap Syphon. Sidney W. Miller, Chicago, Ill.

12,226. Reissue. May 31, 1904. Syphon. Sidney W. Miller, Chicago, Ill.

762,241. June 7, 1904. Street-Sweeping Machine. Hiram D. Layman and Florence W. Parpart, New York, N. Y.

762,466. June 14, 1904. System of Sewage Disposal. Wm. L. Church and Geo. E. Hill, New York, N. Y.

763,026. June 21, 1904. Apparatus for Treating Sewage. Wm. J. Schweitzer, Whiteplains, N. Y.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Atlantic City, N. J.—The Cleveland Trinidad Asphalt Co. has appealed to the court of errors against the decision of the state supreme court, setting aside the ordinance for the paving of Atlantic ave. and all of the proceedings which city council had authorized under it, including the contract with the company for asphalt paving, etc.

CONTEMPLATED WORK.

Brainerd, Minn.—Council will macadamize an alley.

Snohomish, Wash.—The improvement of Pine st. is proposed.

Sioux City, Ia.—Paving is proposed for Court and Iowa sts.

Zanesville, Ohio—Paving is contemplated for Fountain Square.

Neenah, Wis.—Council is preparing to pave several streets with brick.

Manchester, Ia.—Brick paving is proposed for Franklin and Main sts.

Ruthven, Ia.—Council has ordered sidewalks constructed of brick or cement.

Allegheny, Pa.—Grading, paving and curbing is proposed for Herman st.

Shamokin, Pa.—The residents of 6th and Arch sts. have petitioned for paving.

Reynoldsville, Pa.—Council has decided to pave Jackson st. from 7th to Bradford.

Gladstone, Mich.—Council contemplates paving the streets with concrete blocks.

Napoleon, Ohio—The property owners on Scott st. have petitioned for brick paving.

Decorah, Ia.—City council has decided to construct 10 blocks of paving this year.

Hot Springs, Ark.—City council is considering the question of paving Central ave.

Anaconda, Mont.—Paving is contemplated for Main st. from Cooper to Woodland sts.

Fort Madison, Ia.—Grading and curbing is contemplated for 3d and 4th sts. Mayor Brown.

Bay City, Mich.—The board of trade favors the paving of Garfield ave. and Broadway.

Tampa, Fla.—Estimates have been prepared for considerable vitrified brick paving.

Worcester, Mass.—Council has appropriated $30,000 for permanent street improvements.

Hastings, Minn.—Council committee will consider concrete paving and prices on brick.

Creston, Ia.—Final action will be taken July 10 on the proposed paving of several blocks.

Larimore, N. D.—The construction of permanent walks is contemplated in several streets.

Flanagan, Ill.—The village board contemplates the construction of 13 blocks of cement walks.

Logansport, Ind.—A resolution was passed June 7, directing that North st. be paved witm bitulithic.

Albert Lea, Minn.—Brick paving is proposed for the main thoroughfare of this city this summer.

Burlington, Ia.—A resolution has been passed to pave alley No. 7 and No. 4 with brick. Mayor Caster.

Muskegon, Mich.—A hearing will be held July 3 on the proposed paving of Irwin st. from Peck to Nims.

Wellston, Ohio—Ordinances have been passed providing for brick paving in several alleys. R. Jones, mayor.

Newark, N. J.—The bd. of wks. has decided to pave New, Lock and Pine sts. with brick or granite block.

La Salle, Ill.—This city contemplates constructing 100,000 sq. ft. of pavement. C. M. Rickard, cy. engr.

Decatur, Ill.—The residents of Union st. are in favor of asphalt paving with combination curb and gutter.

Allentown, Pa.—Ordinances have been passed providing for paving, according to press reports. Mayor Yost.

Philadelphia, Pa.—An ordinance has been passed authorizing the paving of a number of streets with asphalt.

Ashtabula, Ohio—The city engr. has been directed to prepare plans and specifications for paving Fairfield ave.

Sulphur Springs, Ohio—About 3 mis. of crushed stone will be laid in this (Liberty) towp. this fall. Address twp. clk.

Leavenworth, Kan.—City council has passed an ordinance to pave 4th st. south to the city limits. Ed. Jones, cy engr.

Hibbing, Minn.—Council is preparing to pave the principal streets. The material has not yet been decided upon.

Brooklyn Heights, Ohio—The village voted, June 19, to issue bonds for constructing a number of street improvements.

Akron, Ohio—City council decided, June 19, to resurface Howard st. with asphalt, and bids will be asked at once.

Omaha, Neb.—Andrew Rosewater, cy. engr., has proposed that the cobblestone paving on Farnam st. be replaced with asphalt.

Canal Dover, Ohio—An ordinance has been approved for paving Wooster ave. with brick or block. Alfred Nydegger, cy. clk.

Salt Lake City, Utah—Paving is contemplated on Brigham st. from Seventh East to Tenth East sts. W. H. Wilkins, clk. B. P. W.

Springfield, Ohio—Resolutions have been passed for paving certain alleys with vitrified brick or block. W. H. Schaus, prest. coun.

Bridgeport, Conn.—This city contemplates constructing 7,800 sq. yds. of brick, wood block or bitulithic paving. W. W. Starr, cy. surv.

Jacksonville, Fla.—The city engr. estimates the cost of paving Gilmore st., from Riverside ave. to the river, with brick, at $712.54.

Dunkirk, N. Y.—Resolutions have been passed for paving certain streets with brick, and Center st., east of the switch, with macadam.

York, Neb.—The Commercial Club has passed a resolution urging city council to take steps toward paving the principal streets of this city.

Warren, Ohio—An ordinance has been

approved providing for asphalt block paving on Scott st. from N. Park ave. to N. Elm st. M. J. Sloan, mayor.

Osceola, Ia.—W. N. Temple, cy. clk., desires to correspond with cement men, preliminary to constructing from 20,000 to 25,000 ft. of cement sidewalks.

Shawnee, Ok.—City council has authorized 2-mis. of paving on Broadway and 1-mi. on Main st. About 5-mis. of additional paving is also contemplated this fall.

Lansing, Mich.—H. A. Collar, cy. engr., has been directed to prepare plans and specifications for paving Ottawa st., from Washington ave. to Sycamore st., ½-mi.

Fairview, Mich.—The village council has decided to pave with brick, sheet asphalt or bitulithic on concrete, and contracts will probably be let during July.

Delaware, Ohio—A resolution has been passed providing for grading, macadamizing and curbing Pennsylvania ave. from Sandusky to Liberty sts. H. C. Clippinger, mayor.

Springfield, Mass.—The establishment of trunk highways out of this city in all directions has been proposed by the Springfield Automobile Club. William L. Dickinson, chmn.

Winnipeg, Man.—H. N. Ruttan, cy. engr., estimates the cost of paving Higgins ave. from Maple st. to subway, at $62,000 for asphalt, and $82,000 for creosoted blocks.

Centralia, Ia.—City council has rescinded the resolution providing for asphalt paving on E. State and E. Maple sts. and adopted a new one for brick paving, which will come up for final hearing July 12.

Winona, Minn.—A petition will be circulated asking that W. 5th st., from Main to the M. & St. Paul track, be paved. The residents on Main st., from Broadway to the M. & St. P. track, have asked for brick paving.

Centralia, Ill.—Special.—The board of local improvements has directed the Iowa Engineering Co., of Clinton, Ia., to prepare plans and estimates for 89,000 sq. yds. of brick street paving, to be used soon after July 1.

Bloomington, Ill.—An ordinance was passed June 16, providing for the resurfacing of Main and Center sts., from Front to Monroe, and of Washington and Jefferson sts., from Madison to East sts., with asphalt. Cy. Engr. Folsom.

Columbus, Ohio—Cy. Engr. Griggs submitted estimates, June 12, for paving, as follows: West Park ave., Town to Sullivant sts., brick, $19,770.50; asphalt, $22,220.50; Hildreth, from Bolivar to 20th, $4,341; Tompkins, from High to Dayton, brick, $18,391; asphalt, $20,766.

Dayton, Ohio—Cy. Engr. Turner has submitted plans and estimates for paving Broadway, from Wolf creek to north corporation line, as fololws: Brick, $1.65 a sq. yd.; bitulithic, $2.10; asphalt, $2.10; cement curb, 60 cts. a lin. ft.; stone curb, 60 cts.; protection curb, 50 cts.; circular curb, $1.20.

CONTRACTS TO BE LET.

Monroe, Wis.—Bids are asked until July 7 for macadam paving and cement curbing. Cy. engr. Icke.

Knox, Ind.—Bids are asked until July 5 for constructing macadam roads. Lee M. Ransbottom, co. audt.

Cleveland Heigths, Ohio—Bids are asked until July 11 for grading Mayfield road. Wm. G. Phare, cil. clk.

Beloit, Wis.—Bids are asked until July 8 for paving 4th st. with vitrified block. Robt. R. Caldwell, cy. engr.

Logansport, Ind.—Sealed bids are asked until July 5 for constructing a gravel road. O. C. Gard, co. audt.

Mount Holly, N. J.—Bids are asked until July 5 for building stone roads in various townships. Joel Horner, dir.

Paoli, Ind.—Bids are asked until July 5 for constructing three macadam or gravel roads. Alvin B. Ham, co. audt.

Lidgerwood, N. D.—Bids are asked until July 3 for constructing sidewalks during the year. F. W. Mashek, cy. audt.

Peekskill, N. Y.—Bids are asked until July 11 for 4,140 sq. yds. of brick paving. Albert E. Cruger, vil. clk.

St. Paul, Minn.—Bids are asked until July 17 for grading and macadam work on county roads. E. G. Krahmer, co. audt.

Vernon, Ind.—Bids are asked until July 3 for constructing about 2-mis. of pike road in Spencer twp. Bd. co. comrs.

Trenton, N. J.—Bids are asked until July 3 for constructing a macadam road in Cadwallader Park. Park comrs.

York, Pa.—Bids are asked until July 8 for constructing 6,140 ft. of road. Jos. W. Hunter, supt. state highway comrs.

Oshkosh, Wis.—Bids are asked until July 8 for grading and macadam paving on Franklin ave. from Church to Irving. B. P. W.

Vincennes, Ind.—Bids are asked until July 7 for constructing 3,710 ft. of road in Vincennes twp. John I. Scott, co. audt.

Gardner, Ill.—Bids are asked until July 10 for constructing 25,000 sq. ft. of cement concrete sidewalks. J. R. Suffern, vil. clk.

Emlenton, Pa.—Sealed bids are asked until July 5 for 9,275 sq. yds. of brick or asphalt block paving on Main st. F. H. Krear, sec'y.

Greencastle, Ind.—Bids are asked until July 3 for constructing 19,740 ft. of roads in various townships. C. C. Hurst, co. audt.

Clarinda, Ia.—Bids are asked until July 7 for constructing 10,380 sq. yds. of brick paving and 6,955 lin. ft. of curbing. Cy. clk.

Ashland, Ohio—Sealed bids are asked until July 11 for grading, paving and curbing with brick Cleveland ave. C. P. Winbigler, mayor.

Greensburg, Ind.—Bids are asked until July 3 for building macadam roads in Sand Creek, Adams and Clinton twps. Frank E. Ryan, co. audt.

Woodville, Ohio—Bids are asked until July 3 for paving Maumee pike with brick or block, aggregating about 12,580 sq. yds. Otis Bitinger, clk.

Clark, S. D.—Bids are asked until July 5 for constructing cement street crossings, curb, cement gutter and sidewalk work. F. M. Harris, cy. audt.

Argenta, Ark.—Bids are asked until July 6 for 8,000 sq. yds. of paving on W. 4th st. C. J. Humphreys, W. H. Ramsey and Dr. A. R. Powell, comrs.

Xenia, Ohio—Bids are asked until July 27 for paving Market st. with brick, asphalt or bitulithic, aggregating about 17,430 sq. yds. J. E. Jones, clk. B. P. S.

Upper Sandusky, Ohio—Sealed bids are asked until July 5 for constructing 7,500 ft. of pike in Crane twp. L. C. Kinley, chmn. twp. trustees; W. E. Bowsher, co. clk.

Harrison, N. J.—Sealed bids are asked until July 11 for 6,840 sq. yds. of street paving on Worthington ave., with curbing, manholes, etc. B. P. Walsh, town clk.

Lawrence, Kan.—Bids are asked until July 3 for improving Elliott st. as follows: 11,500 sq. yds. macadm; 5,000 lin.

ft. limestone or concrete curbing. F. D. Brooks, cy. clk.

Washington, D. C.—Bids are asked until July 20 for furnishing and delivering 7,800 tons of broken stone for constructing roadways in Potomac Park. Col. Chas. S. Bromwell,

Freehold, N. J.—Bids are asked until July 12 (readvertisement) for building the first section of the Allentown and New Egypt stone road, aggregating about 3½-mis. John Guire, dir.

Des Moines, Ia.—Bids are asked until July 7 for paving W. Walnut st. with asphalt, including relaying 900 sq. yds. of brick paving, laying vitrified sewer pipe, etc. W. W. Wise, chmn. B. P. W.

Perth Amboy, N. J.—Sealed bids are asked until July 3 for paving State st., from Gordon to Market sts., with vitrified brick or Bermudez asphalt, and for grading Sheridan st. Wm. H. Fullerton, st. comr.

Waterbury, Conn.—Bids are asked until July 18 for paving Grand st. with wood block, vitrified brick or bitulithic, and for paving certain portions of other streets with bitulithic. R. A. Cairns, cy. engr.

CONTRACTS AWARDED.

Colfax, Ill.—The contract for constructing 10,000 ft. of concrete walk was awarded to Harvey Lebo.

Racine, Wis.—The contract for paving Villa st. with vitrified brick was awarded to the La Crosse Stone Co.

Freeport, Ill.—M. Ford, of Cedar Rapids, Ia., was awarded the contract for paving Liberty st., for $36,342.22.

Cleveland, Ohio—The contract for paving Bedford road with brick was awarded to the Trinidad Paving Co., for $30,800.

Erie, Pa.—The contract for paving Ash st. with brick was awarded to John McCormick & Son, at $1.34 a sq. yd.

Albany, N. Y.—The contract for granite block paving on Liberty st. was awarded to M. F. Dollard, at $2.28 a sq. yd.

Des Moines, Ia.—The Barber Asphalt Paving Co. was awarded the contract for paving several streets, at $1.64 a sq. yd.

Oxford, N. Y.—The contract for 6,700 sq. yds. of macadam paving was awarded to Frank Pidgeon, of Saugerties, for $10,000.

Hagerstown, Md.—The contract for building 2-mis. of turnpike was awarded to John Clarkson, of this city, for about $7,000.

Danville, Ill.—The contract for grading and macadamizing streets and building cement sidewalks was awarded to Alpheus Cruzan, for $3,000.

Newark, N. J.—The Newark Paving Co. was warded the contract, June 15, for brick paving on 2d, Alpine and Hunterdon sts., for $58,825.60.

Iowa City, Ia.—The Barber Asphalt Paving Co. was awarded the contract, June 10, for constructing bituminous macadam paving, at $1.96 a sq. yd.

Falmouth, Mass.—The contract for building two sections of highway and resurfacing another was awarded to Chas. Thomas, of Middleboro, for $9,649.

Tamaqua, Pa.—The contract for 2,500 sq. yds. of brick paving on Mauch Chunk st. was awarded to the Coryell Const. Co., of Williamsport, for $5,775.

Owensboro, Ky.—The Eigenmann Contract Co. was awarded the contract for building 50,000 sq. ft. of concrete sidewalks in this city, for about $12,000.

Freehold, N. J.—The contract for building a stone road from Freehold to Colt's Neck, 33-mis., was awarded to W. C. Shanley, of Newark, for $22,874.

Jersey City, N. J.—The Barber Asphalt Paving Co. was awarded the contract for paving Newark ave., from Warren to Brunswick st., at $2.46 a sq. yd.

Somerville, Mass.—Special.—Contracts for paving Medford and Pearl sts. and Gilman Square with bitulithic have been awarded to Warren Bros. Co., of Boston.

Youngstown, Ohio—The Ohio Stone & Paving Co. has been awarded the contract for constructing from 15,000 to 20,000 sq. ft. of cement sidewalks in the East End.

Bedford, Ind.—The contract for paving four blocks of brick paving with stone walks on J st. was awarded, June 21, to Robert Naegel, of Greencastle, for $16,814.90.

Des Moines, Ia.—The King-Lambert Construction Co. was awarded contracts, June 15, for paving Forest ave., and Charles and Grove sts. with brick, at $1.67 a sq. yd.

Milwaukee, Wis.—Contracts for constructing brick and granite street paving were awarded to Henry Hase, for $31,018.75. His bid on brick paving was $1.77 a sq. yd.

Worcester, Mass.—Special.—The contract for paving Main st., from Hawthorne to Hammond and Bloomingdale road, with bitulithic, was awarded to Warren Bros. Co., of Boston.

Portland, Me.—Special.—The contract for paving Spring and Portland sts. and Cumberland and Pleasant aves. with bitulithic was awarded to Warren Bros. Co., of Boston.

Joliet, Ill.—The Conway Asphalt Co., of Chicago, was awarded the contract, June 11, for paving Richard st., from Washington st. to 4th ave., with asphalt, at $1.24 a sq. yd.

Augusta, Ga.—The contract for paving Jackson st. with vitrified brick, from Broad to Walker, and from New Walker to Old Walker with Belgian blocks, was awarded to W. F. Bowe.

Moline, Ill.—The contract for paving 13th ave., from 9th to 15th sts., with asphalt, was awarded, June 10, to the McCarthy Construction Co., of Davenport, Ia., for $14,200.

Corona, Cal.—The contract for grading, curbing, gutters, sidewalks, etc., on Main st., from the depot to Olive st., was awarded to Charles Stansbury, of Los Angeles, for $22,446.

San Francisco, Cal.—The contract for widening the roadway of Mission st., between 2d and 5th, and repaving with basalt blocks, was awarded to Flinn & Treacy, for $39,649.

Waterbury, Conn.—Paving contracts were awarded, June 9, as follows: Benedict st., Metropolitan brick, Keating & Egan, $3,948; N. Main and Scovill sts., Mack brick, $2.62½ a sq. yd.

Boston, Mass.—Contracts for building highways have been awarded as follows: 4,200 ft. in Tewksbury, F. E. Ellis, of Melrose, $5,384; 2,100 ft. in Chester, N. L. Camarco, of Lee, $3,446.

Batavia, N. Y.—John Mahoney, of Jamestown, N. Y., was awarded the contract for paving Main and Jackson sts., in the business section of the town, with Clearfield block, for $25,617.40.

Bloomfield, Ind.—Contracts for building new roads were awarded, June 6, as follows: Cass twp., Miller & Rapp, of Seymour, $10,730; Grant twp., $18,947.75, and roads Nos. 1, 2, 3, 4, 5, 6 and 7, $20,967.74, Musselman & Slinkard.

Mankato, Minn.—Coughlan & Co. secured the contract, June 14, for curbing and guttering S. Front st., from Liberty to Lamm, for $2,163.84, and Fowler & Pay were awarded the contract for curb-

ing, guttering and otherwise improving Byron st.

Cincinnati, Ohio—Paving contracts were awarded June 6, as follows: Pike st., bitulithic, Henkel & Sullivan, $7,797.65; Poplar st., asphalt, Barber Asphalt Paving Co., $4,122; north side 5th st., from Vine to Walnut, Barber Asphalt Paving Co., $2,407.87.

St. Paul, Minn.—The Barber Asphalt Paving Co. was awarded the contract for paving 8th st., from Broadway to Locust, with asphalt, for $11,218. The contract for boulevarding Sherburne ave., from Rice to Dale, was awarded to Fielding & Shepley, for $9,600.

Walla Walla, Wash.—The contract for constructing cement sidewalks and curbing around the courthouse was awarded to George Snell, of this city, at 19 cts. a sq. yd. for sidewalks and 49 cts. a lin. ft. for curbing. The work aggregates 14,500 sq. yds. of walks.

Tacoma, Wash.—The Independent Asphalt Paving Co. was awarded the contract for paving Jefferson ave., from Pacific ave. to C st., with asphalt, for $13,200. The bid for asphalt paving was less than $2 a sq. yd., which is the lowest bid ever submitted here for that material.

Waterloo, Ia.—The contract for three blocks of paving on the east side streets and the Melan arch bridge was awarded to M. Ford, of Cedar Rapids, at $1.92 a sq. yd. for the streets and $1.98 for the bridge. Purington repressed vitrified brick block with cement filler will be used.

Morristown, N. J.—Contracts for constructing three sections of state road were awarded June 19, as follows: Morris Plains and Parsippany roads, Dickerson & Gill, of Rockaway, $13,044.92; Montville and Mountain View road, J. B. Salmon & Co., $14,346.85; Green Village and Madison road, Dickerson & Gill, $9,497.74.

Buffalo, N. Y.—Bids were submitted June 16 for paving, the lowest being as follows: Harmonia st., from Sycamore st. to Walden ave., Barber Asphalt Paving Co., asphalt, $6,676; Alabama st., from Sandusky to Tecumseh, Barber Asphalt Paving Co., asphalt, $3,238.11; Stanislaus st., from Fillmore ave. to Loepers st., Barber Asphalt Paving Co., asphalt, $9,102.60.

Bay City, Mich.—The Cleveland Trinidad Asphalt Co., of Cleveland, Ohio, submitted the lowest bid, June 16, for paving Columbus and Woodside aves. The company's bid was for asphalt paving and was $31,357. The lowest bid for brick was submitted by M. J. Meagher, who bid $33,425, making a difference of $2,068 in favor of the asphalt bid. The contract has not yet been awarded.

Toronto, Ont.—Special.—The Central Bitulithic Paving Co., of Detroit, Mich., was awarded the contracts for bitulithic paving on Bismarck aves., Gerrard, Charles and Roxboro sts. and Dunbar road. The city council has also directed that tenders be received for bitulithic paving on Defoe and Frederick sts., Scarth road, and Bain and Pape aves., in recognition of petitions for bitulithic pavements signed by the owners of more than two-thirds of the frontage on each street.

Brooklyn, N. Y.—Contracts were awarded June 14, as follows: Regrading and laying cement sidewalks on 74th st., from 2d to 7th aves., N. Schneider's Sons, 144 21st st., N. Y. city, $19,676; regrading and repaving with granite on concrete, Kent ave., from Hewes st. to Clymer st., Cunningham & Kearns, 439 E. 81st st., N. Y. city, $16,088; regrading and laying cement sidewalks on Blake ave., from Hopkinson to Howard aves., Uvalde Co., 1 Broadway, $12,193.

SEWERS.

Hopkinsville, Ky.—The Hopkinsville Sewerage Co. has been incorporated.

Freeport, N. Y.—The South Shore Sanitary Co. has been incorporated to construct sewerage systems, etc., by Chas. C. Moore, Zophar Smith, Freeport; Eugene Gilroy, N. Y. City.

CONTEMPLATED WORK.

Rock Falls, Ill.—A sewerage system is contemplated.

Evansville, Ind.—Plans are being prepared for building two sewers.

Huron, S. D.—The construction of a main sewer is contemplated.

Gladstone, Mich.—The question of constructing a sewerage system is being agitated.

Troy, Ala.—The construction of a sewerage system is contemplated. Address mayor.

Butte, Mont.—A sewerage system on Talbot ave. has been proposed by the sewer committee.

Warren, Ohio—An outlet trunk sewer in district No. 1 is contemplated. M. J. Sloan, mayor.

Cedar Springs, Mich.—This village voted to issue $5,000 bonds for street improvements.

Tampa, Fla.—Estimates have been completed for the construction of a complete sewerage system.

Centralia, Ia.—Objections to the proposed sewers in sections 5 and 6 will be heard July 10.

Thebes, Ill.—A report has been made on the probable cost of constructing a sewerage system here.

Woburn, Mass.—The bd. of pub. wks. asks council for $1,000 for constructing a sewer on Jefferson st.

Dixon, Ill.—A public hearing will be given July 3 on the proposed construction of the West Dixon sewer.

Binghamton, N. Y.—The city voted to issue $85,000 bonds for constructing a trunk sewer in the 4th ward.

Gadsden, Ala.—This city will vote July 10 on the issue of bonds for constructing a sewerage system. Address mayor.

Cape May, N. J.—Council has passed an ordinance for building about 1-mi. of sewer in the new East Cape May tract.

Zanesville, Ohio—Plans have been prepared by City Engineer Smith for constructing a storm sewer on Greenwood ave.

South Bethlehem, Pa.—Borough council contemplates issuing bonds for the construction of a house sewerage system.

Alliance, Ohio—Bids for constructing about 25,000 lin. ft. of sewers will be received about August 5. E. Pfouts, cy. engr.

Wyandotte, Mich.—Plans and specifications for a gravity system of sewers will be prepared by Mason L. Brown, of Detroit.

Medicine Hat, N. W. T.—The question of issuing bonds for the construction of a sewerage system will be submitted to vote.

Akron, Ohio—Plans are being prepared by City Engineer Payne for the construction of an independent storm sewer in Valley st.

Elizabeth, N. J.—The board of health

will recommend the construction of a sewer in Murray st. W. H. Luster, Jr., cy. engr.

Portland, Ore.—Plans for the proposed Brooklyn District sewer will be completed in about sixty days. Chas. Wanzer, cy. engr.

Louisville, Ky.—Plans have been submitted to Mayor Grainger and the board of public works for the proposed outfall sewer.

Sheridan, Wyo.—The question of issuing $38,000 bonds for building a sanitary sewerage system has been favorably voted on.

Covington, Ky.—The construction of a concrete sewer on Bullock st., from 13th to Monterey, at a cost of $7,037.60, is contemplated.

Danville, Ill.—The construction of 2,600 ft. 36-in. brick and 4,500 ft. 15 to 24 in. pipe sewers is contemplated. W. H. Martin, cy. engr.

Grenada, Miss.—This city will vote July 5 on the issue of $30,000 bonds for extending the sewerage system and making other improvements.

Chattanooga, Tenn.—The St. Elmo Sewerage Co. has been incorporated to construct an independent sewerage system, embracing the town of St. Elmo.

Barberton, Ohio—The bids for constructing a concrete sewer on Baird ave. have been rejected, and new bids for a brick sewer will probably be asked.

Delaware, Ohio—A resolution has been passed to build a drain or ditch of sewer pipe or drain tile in certain streets and alleys. H. C. Clippinger, mayor.

Petersburg, Va.—A committee has been appointed to take charge of the proposed extension of sewers and water mains, and improvements of sidewalks. G. B. Gill, cy. audt.

Newark, N. J.—The sewer com. of the bd. of wks. has recommended the construction of a new sewer in Sussex ave., preparatory to the repaving of that street next year.

McPherson, Kan.—Special.—The city council has directed H. A. Rowland, cy. engr., to make a topographical survey and profiles for the purpose of constructing sewer dist. No. 1.

Dunkirk, N. Y.—The board of health has taken steps preliminary to forcing the city to build a sewerage system at a cost of $50,000, for the relief of the residents in the 4th ward.

San Diego, Cal.—An ordinance was passed June 5, providing for a special election June 22, to vote on the issue of bonds for the construction of a storm water sewer, the improvement of the water system, etc.

Bowling Green, Ohio—The reconstruction of the Poe and tributary sewers and the construction of a large catchbasin to take the place of the sewage disposal plant will cost, it is estimated, about $24,000.

Los Angeles, Cal.—Plans and specifications are on file in the office of the city engineer, J. D. Schuyler, for the construction and erection of a sewage pumping plant and pump house at the Ocean septic plant, and for a wood stave discharge pipe from the tank to sewage farm.

CONTRACTS TO BE LET.

Stephan, S. D.—Bids are asked until July 3 for building a sewer system. Rev. P. Boehm.

Boone, Ia.—Bids are asked until July 10 for constructing drain No. 11. Archie Patterson, co. audt.

Chicago, Ill.—Bids are asked until July 7 for constructing a sewer tunnel, according to press reports.

Le Sueur, Minn.—Bids are asked until July 7 for constructing ditch No. 27. H. A. Ziebarth, co. audt.

Virginia, Minn.—Bids are asked until 8 p. m. July 5 for building a sanitary sewer. A. N. Thompson, cy. clk.

Mamaroneck, N. Y.—Bids are asked until July 12 for building 4-mis. of sewers. Chas. W. Buckter, vil. clk.

Brainerd, Minn.—Bids are asked until 5 p. m. July 3 for constructing 8 and 6 in. sewers. F. E. Low, cy. clk.

Gettysburg, Pa.—Bids are asked until 7:30 p. m. July 3 for constructing a sewer. A. B. Plank, chmn. sewer com.

Westfield, Mass.—Sealed bids are asked until July 17 for constructing storm water sewers. Oren Parks, town engr.

Olivia, Minn.—Bids are asked until July 6 for digging ditch No. 1, aggregating 24,037 cu. yds. H. J. Lee, co. audt.

Groton, S. D.—Bids are asked until July 17 for constructing an extension to the sewerage system. W. A. Burnham, cy. audt.

St. Bernard, Ohio—Sealed bids are asked until July 12 for constructing sewers in a large number of streets. Geo. Meyer, vil. clk.

Marshall, Minn.—Bids are asked until July 8 for constructing 1,384 ft. 15-in. and 1315 ft. 10-in. sewers. John R. Cray, cy. recorder.

Fort Dodge, Ia.—Bids are asked until Aug. 3 for constructing Youglas drain in Washington twp., this county, and Fremon twp., Hamilton co.

Macon, Ga.—Bids are asked until July 8 for the extension of the sewerage system, 6 to 10 mis., to a suburb recently annexed. J. W. Wilcox, cy. engr.

Washington, D. C.—Bids are asked until July 2 for constructing a sewer system at new school, near Wahpeton, N. D. C. F. Larrabee, acting Indian Comr.

Fort Scott, Kan.—Sealed bids are asked until July 5 for constructing sewers in the 4th district, including manholes, lampholes, etc. J. O. Brown, cy. clk.

Utica, N. Y.—Sealed bids are asked until July 21 for building an intercepting sewer about 5,000 ft. long and 11 ft. in diameter, of concrete, brick or stone. J. A. Cantwell, cy. clk.

CONTRACTS AWARDED.

Fargo, N. D.—James Kennedy was awarded the contract for sewer work, June 2, for $52,525.

Gallitzin, Pa.—The contract for constructing a new sewer was awarded to W. G. Stahl & Sons, of Altoona.

Wooster, Ohio—Isaac Greist secured the contract for constructing a sewer on Spink st., June 15, for about $14,000.

Lincoln, Neb.—The contract for constructing a sewer system was awarded to C. G. Sheeley, of this city, for $13,876.89.

Fort Andrews, Mass.—The contract for constructing a sewerage system here was awarded to Rafello & Ferguson, for $2,267.

Columbus, Ohio—The contract for constructing the South Side sanitary sewer was awarded to A. F. Helm, for $12,269.54.

Waterbury, Conn.—Keating & Benedict secured the contract for building sewers in various parts of the city for $2,104.45.

Plainfield, N. J.—The contract for enlarging the sewage disposal plant was awarded to Richards & Gaston, 143 Liberty st., N. Y. City, for $52,047.

Los Angeles, Cal.—The contract for extending the outfall sewer a distance of 280 ft. into the ocean was awarded, June 8, to J. D. Mercereau, for $4,416.

Denver, Colo.—The contract for constructing a sanitary sewer in Highlands special sanitary sewer district No. 8 was awarded, June 9, to the Gaffey & Keefe Const. Co., for $14,983.80.

Albany, N. Y.—Sewer contracts were awarded June 13, as follows: Lancaster st., $2,183.85; Dove st., $960.40; Orange st., $25,128.66, Joseph F. Sheehan. Quail st., Mulderry Bros., $1,419.15; S. Pearl st., John Doyle, $10,067.01.

East Syracuse, N. Y.—Bids were submitted, June 15, for constructing sewage disposal works as follows: Frank Pidgeon, Saugerties, $21,391; De Nalla & Klingburg, Kingston, $19,652; C. T. Hookaway, Syracuse, $16,046; C. R. Lewis, Ilion, $20,954.

WATER WORKS.

Indianapolis, Ind.—The big supply main which the Indianapolis Water Co. is constructing will be completed July 15. The main is for the purpose of bringing an extra large volume of water into the business district of the city as an additional precaution in case of fire.

Leesburg, Va.—Judge C. E. Nicol, of the circuit court, holds that the special election held last spring, to authorize the council to issue bonds ror the establishment of a system of waterworks here, is illegal and void, because it was not ordered by the court on application. This was not done, and the court sustained an injunction to prohibit the sale of the bonds by the town.

Cincinnati, Ohio—The United States court of appeals here rendered a decision about June 15, holding that the Chattanooga Foundry & Pipe Works, a member of the iron pipe trust, must pay back to the city of Atlanta, Ga., $7,000, on the ground that it had formed a trust with other companies and charged the city $7,000 more for water mains and pipes than it would have done if it had had a competitor.

CONTEMPLATED WORK.

Mont Alto, Pa.—The question of a new water supply is being considered.

Waukegan, Ill.—Council has appropriated $20,000 for extending the water intake.

Columbia, S. C.—Bids will probably be received in August for constructing a waterworks plant.

Charleston, N. H.—Final surveys have been completed for the proposed waterworks and sewer systems.

Warrenton, Va.—This town has voted to issue $23,000 bonds to build a new reservoir and appurtenances.

Perth Amboy, N. J.—A new plan for the water supply of this city has been submitted to the water commissioners.

Newport, Ky.—The city engineer has recommended the construction of a filter plant, according to press reports.

Sebastopol, Cal.—The estimated cost of the proposed waterworks and sewerage system is $50,000. Wm. T. Searles, town clk.

Perrysburg, Ohio—An ordinance has been passed providing for the issue of bonds for constructing a municipal waterworks system. E. L. Kingsbury, mayor.

Kennewick, Wash.—Council is considering the application of C. E. Wood, of Genessee, for a franchise for a waterworks and electric light system.

Great Barrington, Mass.—A committee of 25 members will be apointed to consider the different sources of supply and report at a meeting to be held Sept. 15.

Leesburg, Ohio—Special.—This city desires to communicate with a good practical engineer regarding making estimates for a waterworks system. Address clk. of coun.

Milwaukee, Wis.—Chief Meminger, of the fire department, recommends, in his annual report, the extension of the high pressure pipe line system to the manufacturing districts.

New York City—Mayor McClellan has appointed Messrs. J. Edward Simmons, Chas. A. Shaw and Chas. N. Chadwick members of the water supply commission created by act of the recent legislature.

Council Bluffs, Ia.—A special committee of aldermen has been appointed to take charge of the negotiations for the purchase of the waterworks plant, or the construction of a new plant. Mayor Macrae.

The question of issuing bonds for the construction of waterworks systems has been favorably voted on at the following places: Clifton, Texas; Franklin, Tenn.; Fremont, Ohio; Clinton, Ohio; Lone Tree, Iowa.

Newark, N. J.—The construction of a 36-in. main from the Belleville reservoir to Cniton ave. is proposed for the purpose of increasing the pressure of the water supply in the central part of the city.

Manitowoc, Wis.—City council has adopted a resolution declaring that this city will build and operate its own waterworks plant after November 28, 1908, and asked the city engineer for plans and estimates.

La Conner, Wash.—Messrs. F. F. Cook, C. E. Gaches and A. G. Tillinghast have been appointed a committee by the chamber of commerce to urge the council to submit to the people the question of constructing a municipal waterworks system.

The construction of waterworks systems is contemplated at the following places: Leonard, N. D.; Wessington, S. D.; Newton, N. C.; Flora, Ind.; Staatsburg, N. Y.; Lyons Falls, N. Y.; Fredericktown, Ohio; Smithton, Pa.; Jamestown, Pa.; Headland, Ala.

Alton, Ill.—City council has appointed a committee to act with the water committee to devise means for the city to acquire the plant from the water company, and to make extensions to pipe lines, filters, and additions to pumping machinery. H. B. Sparks, chmn. water com.

CONTRACTS TO BE LET.

Bishopville, S. C.—Sealed bids are asked until July 17 for constructing a water works system. W. W. Com.

Halstad, Minn.—Bids are asked until July 7 for laying about 1,600 ft. 4-in. water main. Ole O. Sjordal, vil. recdr.

Waterbury, Conn.—Sealed bids are asked until July 18 for constructing water mains on a number of streets. Robert A. Cairns, cy. engr.

Spokane, Wash.—Sealed bids are asked until July 5 for 18,860 ft. 30-in., 10,800 ft. 24-in. and 7,500 ft. 20-in water mains. B. P. W.

Redfield, S. D.—Bids are asked until

July 11 for sinking an artesian well at the Northern Hospital. State bd. charities and correction.

Havre, Mont.—Bids are asked until July 18 for installing a water main system and a concrete reservoir. C. W. Swearingen, cy. engr.

Yankton, S. D.—Bids are asked until July 3 for a steel standpipe, a cypress standpipe, and a tower. A. D. Russell, cy. clerk.

New York City—Bids are asked until July 5 for furnishing and delivering single and double N. Y. case hydrants. John T. Oakley, comr. water supply, etc.

Columbus, Ohio—Bids are asked until July 5 for furnishing 11,000 tons of 4 to 36 in. c. i. pipe, 65,000 lbs. special castings, etc. Chas. H. Frank, secy. B. P. S.

Yuma, Ariz.—Bids are asked until August 17 for constructing 12-mls. of dike for the reclamation of the Yuma Valley. Supvr. engr., Braly Bldg., Los Angeles, Cal.

Winnipeg, Man.—Bids are asked until July 3 for constructing a covered concrete reservoir to hold 6,000,000 gallons. H. N. Ruttan, cy. engr.; C. J. Brown, cy. clk.

Tama, Ia.—Bids are asked until July 11 for improving the water system, including power house, pumping machinery, boilers, mains and connections. H. A. Ferguson, cy. clk.

Arcanum, Ohio—Sealed bids are asked until 12 m. July 6 for constructing a waterworks system and electric light plant, including pipes, castings, lead, hydrants, valves, pumps, boilers and pumping station. W. W. Hadfield, prest. bd. trustees of pub. affairs.

Washington, D. C.—Bids are asked until July 19 for furnishing a system of pumps and engines for use at Cristobel, Panama, two steam pumps and boilers for Colon waterworks, and two double cylinder hoisting engines and boilers complete, for use at Cristobel. Isthmian Canal Com'n.

Brooklyn, N. Y.—Bids are asked until July 29 for furnishing and installing electrically driven pumps, with all appliances complete, for high pressure fire service, 3 in the pumping station to be erected at Willoughby and Edwards sts., and 5 in pumping station at Gurman and Joralemon sts. Bids are also asked until July 5 for furnishing c. i. pipe and special castings. John T. Oakley, comr. water supply, etc., N. Y. City.

CONTRACTS AWARDED.

Wauwatosa, Wis.—The contract for extending the waterworks was awarded to C. J. Crilley.

Delphi, Ind.—John C. O'Connor was awarded the contract for extending the waterworks system for $54,345.

Pittsburg, Kan.—A 20-year franchise has been granted C. J. Devlin, of Frontenac, for a waterworks system.

Wilmington, Del.—The contract for a new pumping engine was awarded, June 5, to the Holly Mfg. Co., of Buffalo, for $76,769.

Peekskill, N. Y.—The contract for constructing a 20-in. force main was awarded to Charlton & Weston, of Yonkers, N. Y., for $4,297.

Bristol, Vt.—The contract for constructing a new waterworks system was awarded to Deniston & Co., of Rochester, N. Y., for $51,172.

Sullivan, Ind.—The contract for drilling test wells for a new waterworks system was awarded to John Brocksmith, of Freelandville, Ind.

Lafollette, Tenn.—A contract has been awarded the LaFollette Water, Light & Telephone Co. for constructing a water, light and telephone system.

Columbus, Ohio—The contract for constructing a filtration and water softening plant was awarded to Westwater & Casey, of this city, for $514,000.

New York City—The contract for constructing a masonry dam across Cross river, near Katonah Station, was awarded to McArthur Bros. Co., 11 Pine st., N. Y. City, and Winston & Co., Clinton, Mass., for $1,246,212.

Northfield, Vt.—Contracts for the construction of a waterworks system were awarded as follows: Cement reservoir and pipe laying, Flood & Sherrill, Sandy Hill, N. Y., $11,903; pipe, M. J. Drummond & Co., N. Y. City, $21,390.

BRIDGES.

Terre Haute, Ind.—Bids are asked until July 8 for building bridges. Co. comrs.

Spartanburg, S. C.—Bids are asked until July 5 for building two bridges. F. C. West, co. clk.

Haverhill, Mass.—New bids will be asked for building a bridge over Merrimac river. Essex co. comrs.

Wabasha, Minn.—Bids are asked until July 11 for building a steel bridge. S. A. Kennedy, chmn. co. comrs.

Minot, N. D.—Bids are asked until July 3 for building a steel drawbridge over Des Lacs Lake. J. W. Fabrick, co. audt.

Drury, Kans.—Bids are asked until July 10 for building a steel bridge over Chikaskia river. C. A. MacDonald, co. clk.

Martinsville, Ind.—Bids are asked until July 5 for constructing concrete arch and steel bridges. B. R. Johnson, co. audt.

Pikeville, Ky.—Bids are asked until July 6 for constructing a concrete substructure and steel superstructure. Bd. bridge comrs.

Lawrence, Kans.—Bids are asked until July 3 for building stone arched culverts on Mississippi and Winthrop sts. F. D. Brooks, cy. clk.

Jacksonville, Fla.—Bids are asked until July 5 for constructing two steel bridges on the New Orange Park road. F. J. Hyde, chmn. co. comrs.

Weaverville, Cal.—Bids are asked until July 6 for building a combination bridge over Trinity river, near Lowden's ranch. R. Carter, co. clk.

Port Clinton, O.—Sealed bids are asked until July 10 for building bridge abutments and piers, and approaches. Henry Pafenbach, co. audt.

Baltimore, Md.—The Steel Concrete Construction Co. was awarded the contract for erecting a concrete bridge across Gwynn's Falls, at Frederick ave.

Plymouth, Ind.—Bids are asked until July 5 for constructing two iron leg bridges in German twp. and one iron bridge in Green twp. H. L. Singfrey, co. audt.

Owen Sound, Ont.—Bids are asked until July 14 for constructing reinforced cement concrete arches and a steel deck trussed bridge. R. McDowall, town engr.

Portland, Me.—Sealed bids are asked until July 8 for plans, specifications and building a bridge across Fore river, between this city and South Portland. Jas. P. Baxter, chmn. comrs.

STREET LIGHTING.

Clarence, Ia.—This town voted to issue bonds for installing a gas plant.

Monticello, Ga.—This city voted to issue bonds for erecting an electric light plant.

Coin, Ia.—This town voted to issue bonds for erecting a municipal gasoline lighting plant.

Streator, Ill.—Council has appropriated $30,000 for establishing a municipal lighting plant.

Dayton, Ia.—The citizens have organized a light and power company and will install an electric plant.

Hopkins, Minn.—Bids are asked until July 6 for installing a gas plant. E. A. Close, vil. recdr.

Cayuga, Ind.—The Town Board has ordered plans prepared for an electric light plant, and will ask for bids soon.

West Minneapolis, Minn.—Sealed bids are asked until July 6 for establishing a gas lighting plant. Paul Swenson, pres. vil. coun.

Fort Dodge, Ia.—A committee of five has been appointed to investigate the advisability of constructing a gas and electric light plant.

Knoxville, Tenn.—The contract for lighting this city expires July 1, and bids for lighting the city streets with gas or electricity may be asked.

Arcanum, O.—Bids are asked until July 6 for constructing an electric light and water works plant. W. W. Hadfield, prest. bd. trustees of pub. affairs.

Youngstown, O.—Sealed bids are asked until July 5 for one electric light plant for the water works pumping station and filter plant. G. T. Prossor, clk. B. P. S.

Shippenburg, Pa.—Council has created a special committee to investigate the cost of installing and operating a municipal electric light plant. S. A. Angle, chmn. com.

Pensacola, Fla.—Bids are asked until July 15 for constructing a brick and steel building for central power house, at Navy Yard. Mordecai T. Endicott, Ch. Bureau Yds. and Docks, Washington, D. C.

Ensley, Ala.—The Mayor and Board of Aldermen authorized, June 15, the lighting committee to investigate the question of constructing an electric light plant, procure plans and specifications, and report back to the Council July 6.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Port Chester, N. Y.—Bids are asked until July 3 for the disposal of garbage for one year. C. D. Camp, clk.

Kansas City, Kans.—The contract for collecting garbage was awarded to Geo. McClellan and William Gamble.

Hoboken, N. J.—City Council will readvertise for bids for removal of ashes and garbage for the ensuing year.

Bloomington, Ill.—The contract for removal of garbage, ashes, etc., was awarded to D. T. Foster, at $7,500 per year.

Belleville, N. J.—The contract for the collection and disposal of garbage during the next year was awarded to Jas. A. Sloan, for $1,000.

Duluth, Minn.—The contract for the construction of a garbage crematory has been awarded to the Decarie Mfg. Co., of Minneapolis, Minn., for $29,000.

Tacoma, Wash.—The contract for furnishing this city with three street-flushing machines was awarded to the Sanitary Street Cleaning and Sprinkling Machine Co., of St. Louis, Mo., for $4,500.

Washington, D. C.—The contract for collecting and disposing of garbage in the District of Columbia for five years has been awarded to the Washington Fertilizer Co., for $78,400 per annum.

PARKS.

Newark, N. J.—The citizens of the "Iron-bound District" have formed the Riverside Park Association, and will endeavor to secure a park.

FIRE APPARATUS.

LeRoy, Minn.—Council voted to purchase a hose cart and 500 feet of hose.

Waterville, Minn.—The fire department desires to purchase 500 feet of hose, a new cart and other supplies.

Tacoma, Wash.—The contract for furnishing 1,500 feet of 2½-inch hose was awarded to the Pacific Engineering Co. and Hunt & Mottet, both firms of this city.

Rochester, N. Y.—The Gamewell Fire Alarm Telegraph Co. was awarded the contract for furnishing fire alarm boxes, for $493. The Star Electric Co. secured the contract for twelve standards for fire alarm boxes, for $456.

TOO LATE FOR CLASSIFICATION

Denison, Tex.—The question of street paving will be considered by the Board of Trade.

St. Paul, Minn.—Sealed bids are asked until July 17 for macadamizing certain roads. Edw. G. Krahmer, co. audt.

Moberly, Mo.—Bids are asked until July 3 for paving Fort st. with brick, curbing, etc. J. F. Curry, cy. clk.

Creston, Ia.—Sealed bids are asked until July 10 for brick paving on certain streets. J. C. Sullivan, mayor.

Granite City, Ill.—Council appropriated $40,000, June 20, for constructing 2½ miles of vitrified brick paving.

Fort Scott, Kans.—Sealed bids are asked until July 5 for paving Wall st. with vitrified brick. J. O. Brown, cy. clk.

Hartford City, Ind.—The contract for 6,720 sq. yds. of brick paving on Main st. was awarded to Newland & Slatery, for $24,162.

Florence, Ala.—The contract for grading and macadamizing College st., from Cedar st. to the City Cemetery, one mile, will be let soon.

Auburn, N. Y.—Mayor Osborne, in a special message to Common Council, criticized the present sewerage system and advocated more paving.

Hutchinson, Kans.—The contract for paving one mile of Main st. was awarded to Col. James C. Ware, who will use Warren's bitulithic pavement.

Toledo, O.—Mayor Finch will employ an expert electrical engineer to furnish estimates of the cost of installing a municipal lighting plant.

Wichita, Kans.—Sealed bids are asked until 12 m., July 3, for excavating and grading Topeka ave., from 11th to 13th sts. R. N. Dorr, cy. clk.

Massillon, O.—The contract for constructing 18,000 sq. yds. of brick paving was awarded, June 22, to John Meinhart & Son, at $1.09 a sq. yd.

Whitaker, Pa.—Borough Council decided, June 24, to issue $25,000 bonds for street improvements. Water mains will also be laid in several streets.

Pittsburg, Pa.—Bids are asked until July 21 for furnishing and installing compressed air machinery for new lock No. 2. Wm. L. Sibert, major engrs.

Binghamton, N. Y.—The aldermen are considering the matter of laying creoresinate wood block paving on a short section of street where the asphalt has worn out.

Bluffton, Ind.—The Bluffton Construction Co. has been incorporated by F. F. Van Tuyl, J. B. Carter, R. F. Cummins and W. W. Edwards, to build interurban roads and bridges.

Indianapolis, Ind.—Sealed bids are asked until July 5 for constructing a sewer on Gladstone ave.; building cement sidewalks on Ohio st., from Delaware to Massachusetts ave.; grading, graveling and rolling Villa ave., from Prospect to Orange sts. M. A. Downing, chmn. B. P. W.

Birmingham, Ala.—C. M. Burkhalter secured the contracts, June 23, for paving a number of streets and avenues, and Dunn & Lallande the contract for paving first alley, between 22d and 23d sts.

North Braddock, Pa.—Sealed bids are asked until July 5 for constructing 230-ft. 6-in., 630-ft. 12-in., 286-ft. 15-in., 270-ft. 18-in. and 740-ft. 20-in. pipe sewers, 13 manholes and 7 catch basins. C. A. Stewart, borough engr.

Norwood, O.—City Engineer Stewart has prepared estimates for a new sewage disposal system.

Torrington, Conn.—The contract for building 1½ miles of sewer was awarded, June 20, to the Seymour, Clark-Hills Co., of Springfield, Mass., for $9,071.53.

New York City.—Sealed bids are asked until July 5 for furnishing materials and repairing and restoring artificial stone sidewalks and curbing, and resetting natural stone curbing; furnishing and delivering Hudson river road gravel on parks and parkways; single and double nozzle N. Y. case hydrants; c. i. pipe and special castings. John T. Oakley, comr. water supply, etc.

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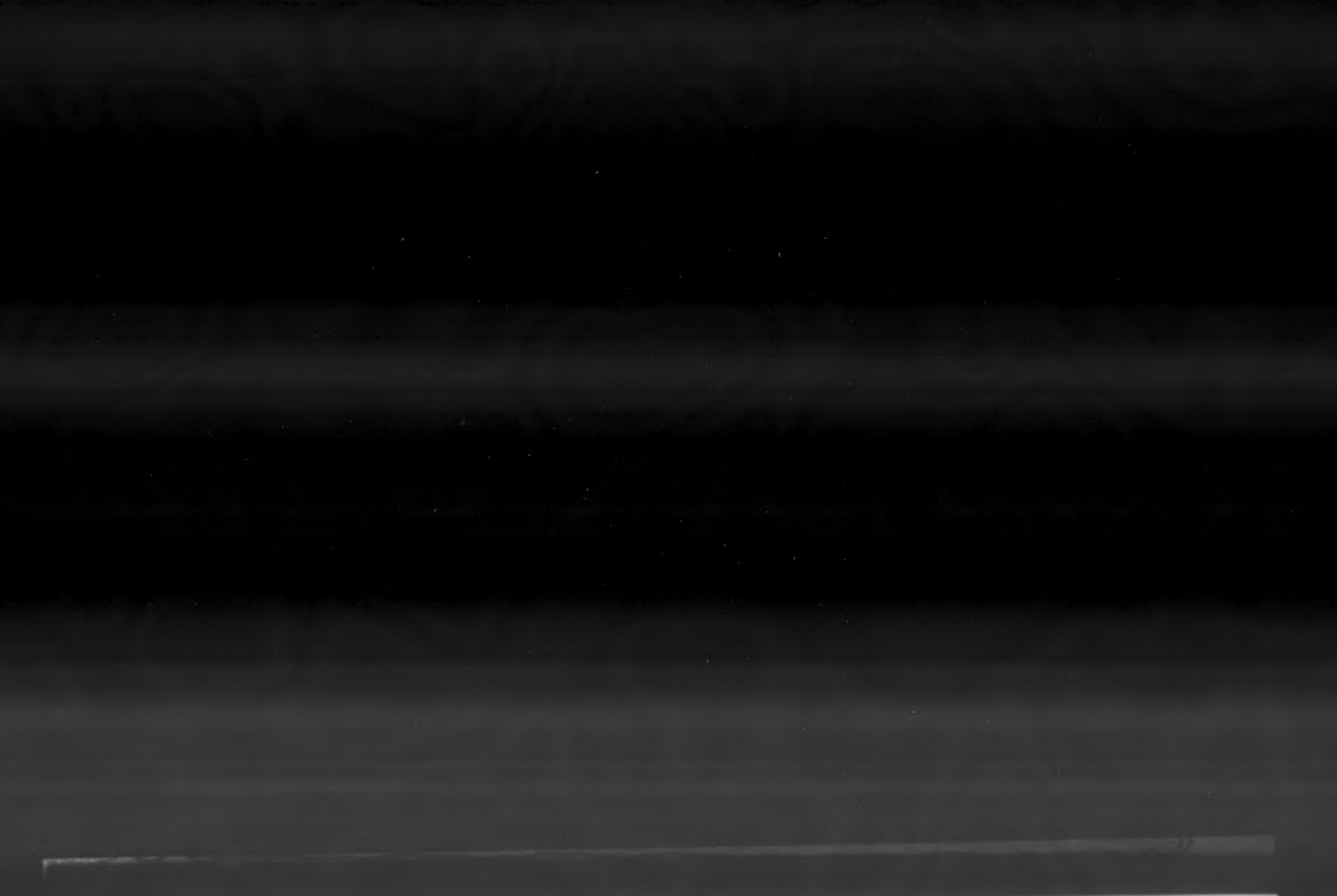
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